Editorial

FROM time immemorial the rising generation has listened with curiosity and boredom to long tales of what went on "when I was young".

I have listened to stories told by my grandfather of the days when people travelled atrocious roads in coaches long before there were motor cars, and when cable trams were considered the newest example of man's genius and resource.

My own memory, like that of many others, goes far enough back to remember chugging motor cars, the first aeroplane flights in Australia, and the first radio signals heard on huge loose coupler coils and crystals. Wonderful!

And still more wonderful, the first valves, some of which I still have, run from huge accumulators, the charging of which was a major operation. And then broadcasting concerts, AC operation, dynamic speakers, and finally the era where my own children have taken over.

So much happened in the first 40 years of the century that it is hard to realise the present generation have always had motor cars, and aeroplanes and radio sets. And just as my grandfather's tales of still earlier days were hard for me to comprehend as real things, still less real to my children are the days when our modern miracles were in the making.

But its good to remember now and then the work and boundless enthusiasm of Australia's radio pioneers. Almost without exception they were idealists—they were in the game as much for the love of it and the fascination of it as for anything else.

One by one they are dropping out, and I don't think their like will be seen again. Television will not produce them, for it is already big business. But radio was something untried, new-fangled, something you had to believe in very greatly to risk with your money and your life work. With TV it is only a matter of time—the stage is set, the equipment is ready, the battle is on.

All this through reading about 2UE's thirtieth birthday, the oldest commercial station in NSW.

I don't know whether it started as ruggedly as the one in which I had my first job in radio, and which used a modulated oscillator of fearsome proportions and design.

But it has played a big part in our radio history.

To 2UE, therefore, and its sister stations who have contributed so valiantly to our radio history, we offer congratulations and best wishes in the new era to come.

John Moyle

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RADIO TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

There is more vacant space in matter than there is solid material — something it is hard for many to visualise. Our student is holding a model showing the molecular structure of phosphor material as used to coat the screens of TV tubes.

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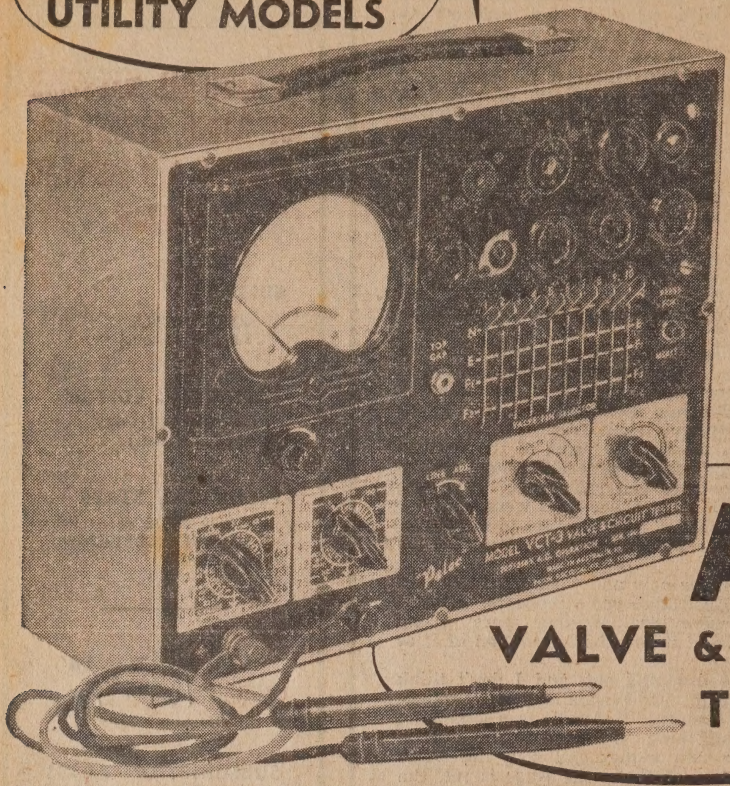

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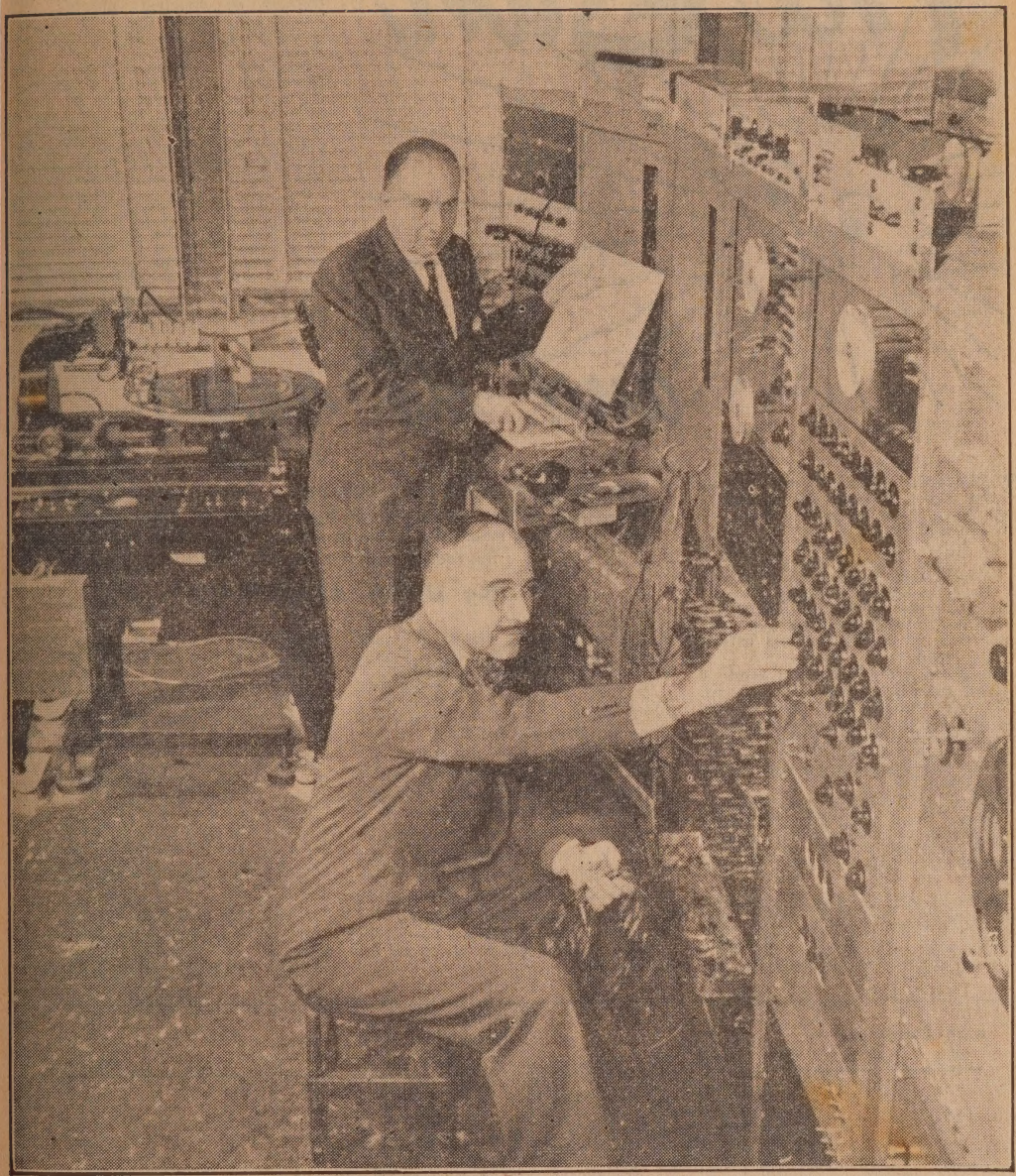
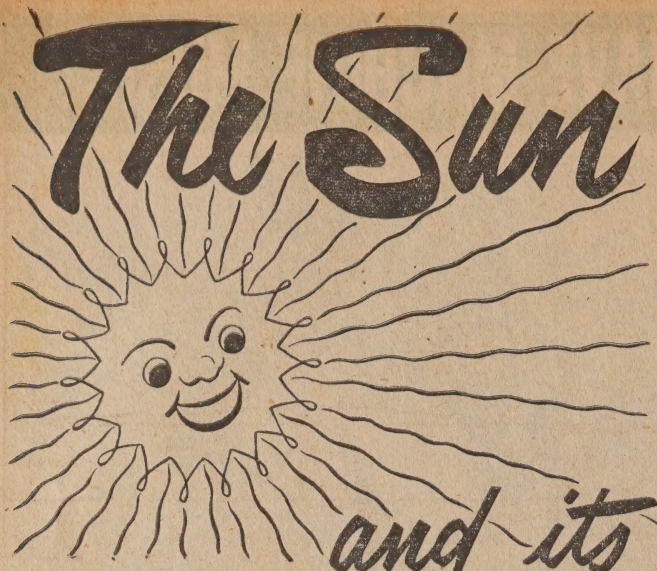
WILL WE HAVE MACHINE MUSIC?



Dr. Harry F. Olsen, background, at the keyboard, and Herbert Belar at the control panel, operate RCA's new electronic music synthesizer. The device can electrically duplicate the tones of any musical instrument and is a tool with which composers and musicians can create effects heretofore impossible. The synthesizer consists of an electronic system housed in metal cabinet and operated with a keyboard. Its output is recorded and played back. Instruments such as this are thought by some to herald a new era of musical composition, and will allow musicians to place their thoughts directly into sound.



If you're in the mood for a little serious reading, you'll appreciate this article, written exclusively for Radio, Television and Hobbies. It explains what is meant by "radiation" from the sun and the effect of this radiation on weather and climate.

By HANS ALBRECHT

THE word, "radiation", reminds us of either "radio" or "radium", and, in fact, both have some connection with it.

To speak as a linguist, the word is a direct relation to the Latin "radiare", meaning "to emit beams of light or heat" (the old Romans had no radio!). This brings us to the interpretation we are actually interested in, as far as this article is concerned.

To speak scientifically, a kind of energy transfer is meant. For us, rays are emitted from one source, and are transmitted to another body, this phenomenon being called "radiation". Such rays consist of electromagnetic waves covering a wide range of wavelengths.

Figure 1 illustrates the electromagnetic wave spectrum beginning with lowest radio frequencies (longest wavelengths) and ending at shortest wavelengths, e.g., gamma rays.

Glancing over the diagram, we find the ordinary broadcast band, the shortwave VHF and UHF bands, the micro-waves, and come to the portion of interest to us, namely, the ranges of infra-red, visible light and ultraviolet waves. This is the region of special meteorological interest.

As with all phenomena in physics, and for that matter, in science generally, certain laws have been found as being valid for radiation.

The first is one indicating the actual radiative properties of a material, i.e., the ratio of "emissive power" to "absorptive power" at a given temperature and wavelength.

This is known as Kirchhoff's law of radiation and its scientific statement reads as follows: At a given temperature, the ratio between the absorptive and emissive powers for a given wavelength is the same for all bodies.

An ideal radiative body would have equal and complete absorptive and emissive powers and the ratio laws was only possible when, around 1900, Planck produced a law of radiation comprising his famous constant of action, the basis of his quantum theory.

This fundamental constant "h" has the value of 6.62 times 10 to the power—27 erg. sec.

Assuming that the radiating body is made up of a very large number of very small elementary oscillating particles, the energy of any one of these is given by Planck's law as:

E equals n x h x f.

Where n x f denotes some multiple of the little oscillator's frequency. However, enough of these would be equal to unity. In reality such a body, a so-called "black body", does not exist. However many physical compounds have properties similar to those of a black body, and its imaginary existence is very helpful.

The energy radiated by a body changes its spectral contents with the temperature of the body. Figure 2 shows how the emission is affected.

Actually, it follows "Wien's Displacement Law", which states that the product of wavelength of maximum radiation and the temperature of the body on the absolute temperature scale (or degrees Kelvin) is a constant, namely 0.2897 if the wavelength is in centimetres.

The actual energy radiated by a "black body" at a certain temperature was found to be proportional to the fourth power of the temperature, again on the absolute scale. This is the Stefan-Boltzmann law.

A full explanation of radiative behavior covered by the two latter

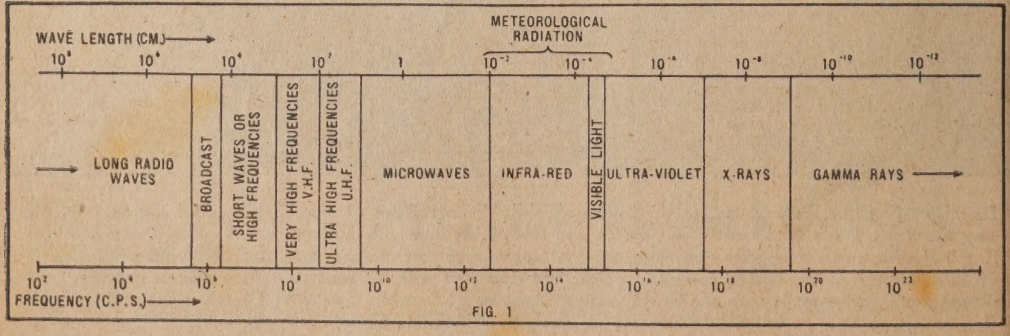


Figure 1: A popular illustration of the electromagnetic spectrum of radiation.

fundamental laws for the present.

One need not be a genius to know that the sun is "the centre, the origin of it all". In other words, the sun is the "primary source" of meteorological radiation.

Although we, in normal latitudes, can only see the sun rising each morning, then climbing to the highest position "at solar noon," and gradually disappearing behind the western horizon, the sun shines continuously. It radiates at a regular rate at all times.

ALWAYS SHINING

A great amount of energy is poured into space and our planet receives only a minute quantity of it. The sun's radiation arrives at the outer limit of the earth's atmosphere with a constant intensity which is, for a mean distance between sun and earth, 1.94 calories per square centimetre and minute.

It is equivalent to about 1.1 kilowatts or 1.47 horsepower per square yard. This all-important "solar constant" was found by the American physicist, Abbot, in the first years of this century.

However, the amount of radiative energy reaching the earth's surface is less than this and depends upon the latitude, the time of the year, and upon possible, but so far unproven, changes of the solar constant.

Besides, the "transparency" of the atmosphere has to be taken into account. In passing through it, the rays lose some of their energy: (1) to a small extent by ionising layers in the ionosphere; (2) mainly by water vapor absorption and (3) by scattering in the troposphere as we will see later.

By now, you may be somewhat confused by so many meteorological terms and a brief explanation of them should not be amiss.

Let's have a look at figure 3 which depicts the earth's atmosphere. The first 10 miles above the surface belong to the "troposphere", followed by the "stratosphere" up to 40 miles, and then the "ionosphere" with its various layers.

These are the D-layer at 50 miles, the E-layer at 70 miles and the F-layers up to 200 miles.

EFFECT OF ATMOSPHERE

Before returning to the sun, we must not overlook the fact that, of the above mentioned atmospheric sections, the troposphere is chiefly responsible for the formation of our weather. However, as shown by latest research, the upper regions may also have a considerable influence on it.

The earth's surface is thus heated primarily by solar radiation, the amount of heat depending, locally, upon the time of the year, the distance between sun and earth, the height of the sun, and cloudiness.

At this juncture we should recall that the earth rotates annually around the sun on an elliptical path which accounts for a change in the distance between sun and earth. It affects the solar constant by about 5 pc.

Then again, the plane of rotation moves from one side of the equator to the other, the limits or planes of reverse being the southern and northern tropic. Only on the days of equinox, the 21st March and the 23rd September does the plane coincide with that of the equator.

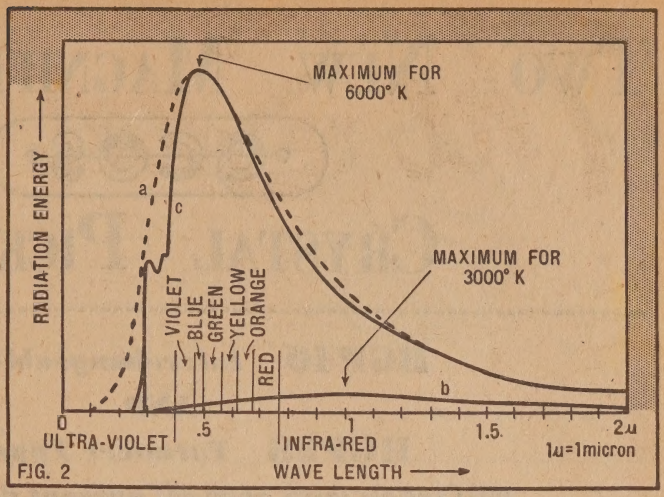


Figure 2: Effect of a body's temperature on the spectral distribution of its radiation. (a) for a body of appr. 6000 deg K, e.g. the sun, (b) for a body of approx. 3000 deg K, (c) the sun's radiation at the outer limit of the atmosphere.

During our — southern — summer the plane of rotation is between the equator and the southern tropic which is reached on the 21st December. To us the height reached by the sun is then at a maximum and therefore, the intensity is larger and the period of insolation is longer.

Cloudiness, as we will see below, can also have a considerable effect on the radiation intensity measured on the ground, because more energy is reflected back at the top of the clouds and the rest is scattered within the clouds.

In other words, clouds an effect similar to that of milky glass.

The surface of the earth re-radiates energy, according to Planck's law, into the atmosphere and up to 80 pc of this energy is absorbed by it.

This is often referred to as the "green house effect" of the atmosphere, because it shows a striking similarity to green house conditions. It means that the atmosphere adopts a local temperature according to the amount of long-wave radiation it consumes.

The atmosphere also emits back to the earth and into space, and this back radiation is called temperature radiation. It is, by the way, the only radiation quantity measurable at the ground during night time.

In this connection the earth's surface may well be called a secondary radiation source with respect to the primary source, the sun.

Figure 4 should simplify appreciation of the factors mentioned above.

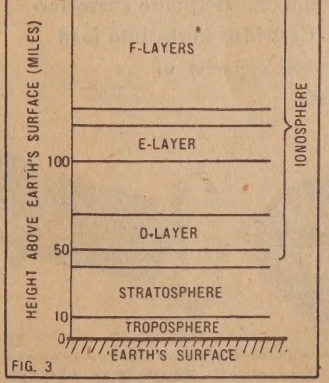


Figure 3: Illustrating the earth's atmosphere and its various layers.

SPECTRAL DISTRIBUTION

We now have sufficient knowledge to investigate the "green house" action and other points of importance in the light of Wien's displacement and Planck's laws.

We have seen that the spectral range of the radiation of a body depends upon its temperature. Vice-versa, the temperature of a radiating body or surface may be determined by measuring the spectral distribution of its radiation. Thus we find, for the uniform portion of the sun's surface, a range as indicated by curves "a" and "c" in figure 2.

The wave-length of maximum radiation is approximately 0.5 micron, which corresponds to a temperature of 6000 degrees on the absolute scale, or approximately 10,000 degrees Fahrenheit.

However, there are specific areas on the sun's surface with a much higher temperature than this. The radiation of these areas extends with its maximum far into the ultra-violet region.

It is clearly beyond the scope of this article to deal with possible causes of such extensive UV-radiation, with assumed temperatures of even up to one-million degrees.

However, solar photographs show effects which may, according to experts, be responsible for such radia-

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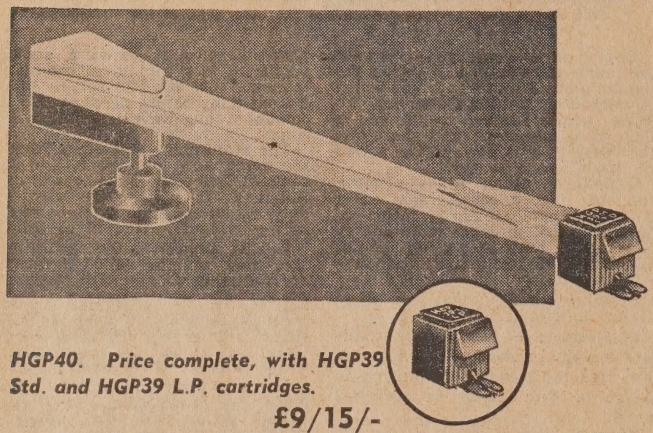

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on. These include solar flares often occurring in connection with in spots) and other solar eruptions.

This UV intensity from the sun nises the ionospheric layers mentioned above, but its main portion is bsorbed by the oxygen in the stratohere, forming ozone. It was for ese reasons that, until a few years go, the sun's UV intensity was not illy realised.

ECENT DATA

However, instruments carried in ckets have since been used to obin data and the bottom left-hand ortion of the solar curve ("c") in gure 2 indicates the path of the rve as is, so far, known.

If we refer to radition below about ve microns as short-wave radiaon and to that above as long-wave adiation, we have two commonly sed terms for spectral ranges of oth primary and secondary sources.

Here we must add that there are number of "dark lines or secons" spread over the whole range f meteorological radiation. An apreciable drop in solar radiation nergy can be noticed within these ections by measurements at the arth's surface.

They are due to absorptions of ertain wave-lengths by water vapor nd oxygen in the atmosphere.

Now the radiation from the earth's rface has a spectral distribution ccording to its temperature. We nd that it lies between 5 and 50 icrons, and this is long-wave radiaon, as is the temperature radiaon from the atmosphere. This tter type of radiation is produced y the elements yielding above-ientioned dark lines or sections.

This is, of course, only valid for loudless skies. A typical curve f radiation distribution is shown n figure 5.

The atmosphere absorbs the outoing radiation (from the earth's urface) mainly by means of its vater vapour molecules which, conequently, re-radiate toward the arth as temperature radiation. laturally, things are very different or a certain amount of cloudiness nd overcast skies.

While, as indicated above, about 5 pc of the solar radiation reachng the outer limit of the atmosphere re lost (i.e. 8 pc are absorbed, 9 pc re reflected from the atmosphere nd another 8 pc from the earth's urface) the percentage of reflected nergy with mean cloudiness increases to about 52 pc and to 78 pc for totally overcast skies.

The reflecting power of the whole earth, or the so-called albedo of the earth, is assumed to be about 0.43, leaving only 57 pc of the intensity given by the solar constant to heat the earth's surface. It has to be pointed out that the reflected radiation has, oxviously, the same spectral distribution as the radiation actually received.

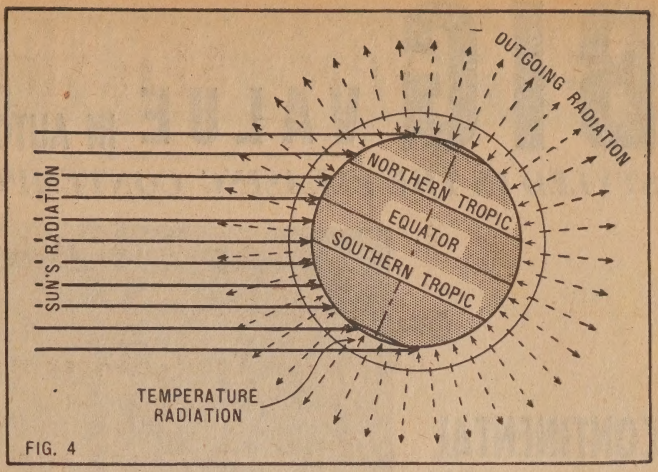

Figure 4: The earth's radiation balance on the 21st December.

INFLUENCE ON WEATHER

It is only natural that as a reader, you will want to know something about the immediate effects on the weather, of the things discussed. While it is an extremely complex subject, some of the more obvious points can be extracted.

Climatic changes in relation with changes in the sun's height are obvious if the paragraphs on the earth's rotation are noted.

Around the equator, i.e. the region between the two tropics, there is a very hot area while, at the poles, the temperature is low. The polar ice is maintained by the long period of winter when the solar energy is not sufficient to melt the ice.

During the summer, however, the sun shines continuously and the energy intake, i.e. the difference between incoming and outgoing radiation per month equals that measured at the equator during the same period. But even that high amount of energy is only able to melt a relatively small amount of ice. Here then, is an obvious influence of meteorological radiation on the climate.

In normal latitudes, we often observe that a clear night during a winter month may be particularly frosty. Well, this also is quite self-explanatory after a study of the relevant paragraphs.

The earth's surface loses a considerable amount of energy received during the day by outgoing radiation, and this results in relatively low temperatures near the surface.

However, if clouds are present, or there is a completely overcast sky, the cloud layer acts as a black body and re-radiates so much of its energy back to earth that the original outgoing radiation is counterbalanced, and we have a warmer night

We must also mention that, according to a theory established a decade ago, solar radiation may be assumed to have a decisive influence on everything which appears to us as "weather". However, to experts, this theory is debatable.

BLUE SKY?

Have you been wondering why this all-enclosing envelope, called "sky", is blue and not yellow, black, red or of some other color?

Here is your answer: As we know, all substances consist of tiny molecules — and air is no exception. In the troposphere, we find molecules of dry air and water vapor as well as those of oxygen in stratospheric heights. In addition, there are dust particles always present.

These molecules and dust particles scatter the light, i.e. they diffusely reflect rays, according to Lord Rayleigh's famous theory of scattering.

For reasons not easily explainable here, the scattering depends, roughly speaking, on wave-length in relation to the physical size of the particles. The amount of scattering is larger the shorter the wavelength and the smaller the physical size.

(Continued on Page 11)

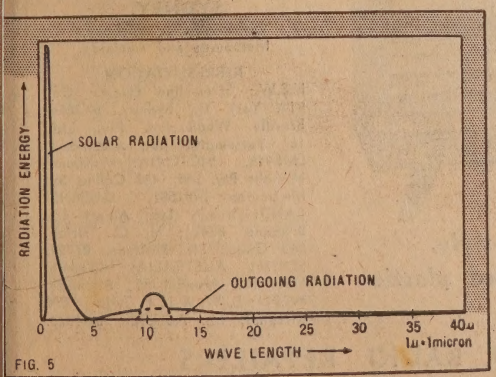

Figure 5: Radiation to and from the earth. Solar radiation below 5 microns is the incoming radiation while the region above that indicates the outgoing radiation with the increased intensity between 9 and 12 microns. This is due to the lack of water vapor absorption in that band which permits the actual surface radiation of the earth to break through.

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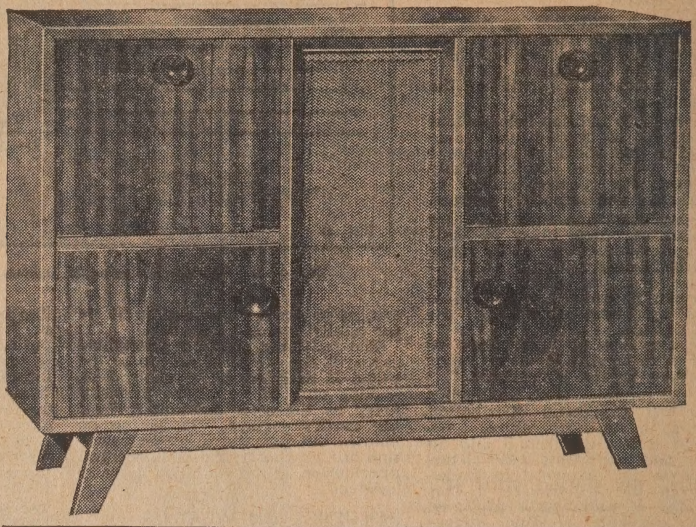

CONTINENTAL

C-79

A magnificently proportioned cabinet in maple veneers, 4ft wide, 35in high and 18in deep, houses this popular 'gram, available with 5, 6 or 8 valves, world-range; 12in speaker; 3 speed record changer. Expanded aluminium grille, with record or glassware storage space on either side increases its appeal.

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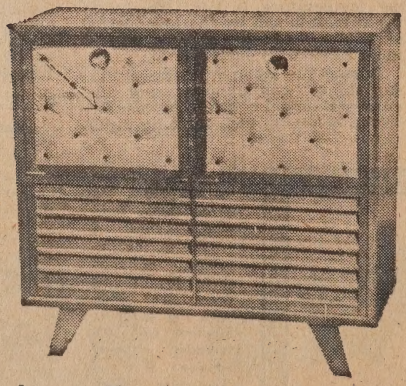
CALibrated to STANdard

RADIOS AND RADIOGRAMS



—another popular Calstan model is the NEW YORKER also available with 5, 6 or 8 valves and other technical features as the Continental, above. The Swedish-style, maple veneer cabinet has studded plastic panels in the very latest trend of today.

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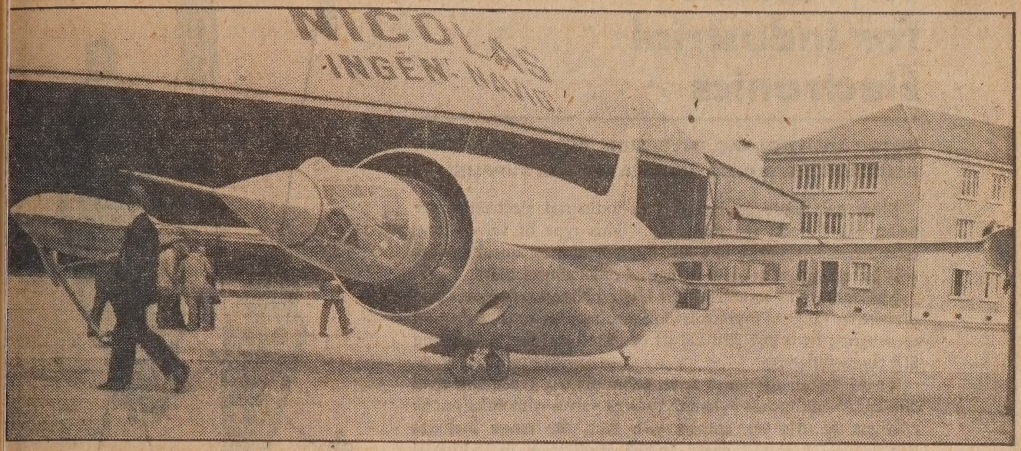

The Leduc 0.21 outside its hangar in Bretigney.

At the moment, French engineers are putting finishing touches to a new jet-propelled aircraft, the Leduc stato-jet, many prototypes of which have been flown with success. The Leduc is based on well-known principles used in the "ram-jet" but it has distinctive features which give it individual character.

By Pierre Devaux

IN the classic turbo-propelled aircraft, the burning gases escape at the rear while turning a turbine which drives the air compressor. This latter supplies the combustion chambers which produce the jet of flaming gas. The cycle is thus complete and continues indefinitely. An electric motor driving the shaft which is common to the compressor and to the turbine is used to start up the engine.

The drawbacks to such a system are that it is mechanical. A "moving body," propelled at high speeds sets problems with regard to running and greasing. Even at hundreds of revolutions per second, a turbine-driven machine does not allow the enormous air cubages the free passage necessary to obtain a high output of power.

The ideal would be the "flying stove-pipe", the simple tube catapulted across space, and in which would burn a suitable combustible (either petroleum or paraffin oil) projected by jets. Fresh air would enter in front, simply through the speed of the plane. The gases would be expelled at the rear at a much higher speed since expansion is caused by combustion. This is the remarkably simple "continuous cycle" of the stato-jet aircraft.

THE BEGINNINGS OF LEDUC

Is such a machine realisable except on paper?

A French inventor, Lorin, thought it possible in 1913. He took out patents, and proceeded to make attempts, but finally abandoned the plans of his thermo-propulsive Tuyere, since metallurgy and the science of fluids were not sufficiently advanced for him to realise it at the time.

In 1938, Rene Leduc undertook the same research. His project was submitted to the Academy of Science in 1936 but then events put a stop to his work. One could say that the "1939 Leduc" was ten years in advance of world technics.

On the 19th November, 1946, the first stato-jet Leduc aircraft was catapulted by a carrier plane (Languedoc 161). This prototype, the 0.10, was a real "flying barrel". In 1951, came the more powerful 0.16, which allowed pilots during the tests to get up to a speed of 1000 kilometres an hour.

THE FLAMING DIABOLO

Imagine a hollow diabolo, in other words, a funnel in the form of a hyperboloid, reminding one of the princess waist" of our grandmothers. It is what is called a "convergent-divergent", or a venturi. Direct a violent current of air at one end and, in the middle of the narrow section, light a flame. The air, heated by the flame, escapes at the rear with a violence which is heightened by the gas expansion.

In this form, the machine will give only a slight propulsive force, with little speed. The great masses of air must be swept to the rear.

In order to do so, the diabolo is installed inside a larger diabolo, in such a way that the gas jet drives the air through the second diabolo in the manner of a blast-pump. In its turn, this diabolo No. 2 is installed in diabolo No. 3, and so on, until there are five of them. This disposition, which is, up to a certain point, classic, and which is used in the "Kylchapp exhaust" of locomotives in order to drive the smoke into the chimney, is in this case capable of a fantastic propulsive force—60 tons for the prototype which will be tried out in 1955—and this without a single revolving part. It is really "the flying blow-torch".

200 METRES A SECOND

The latest model designed by Leduc is the 0.21, which has been tested by the pilot Littolf.

The model is larger. It weighs from five to six tons and carries 2000 litres of motor fuel. The pilot is installed in a transparent cabin, placed in front, and which is releasable in flight, together with an autonomous parachute. There is an undercarriage with two wheels forming a retractable tandem, completed by retractable supports at the wing-tips in order to ensure stability.

The Press throughout the world has pointed out the advantages of vertical flying, now practicable with powerful aircraft equipped with tip-up seats for the occupants. This interesting innovation has been largely surpassed by the possibilities

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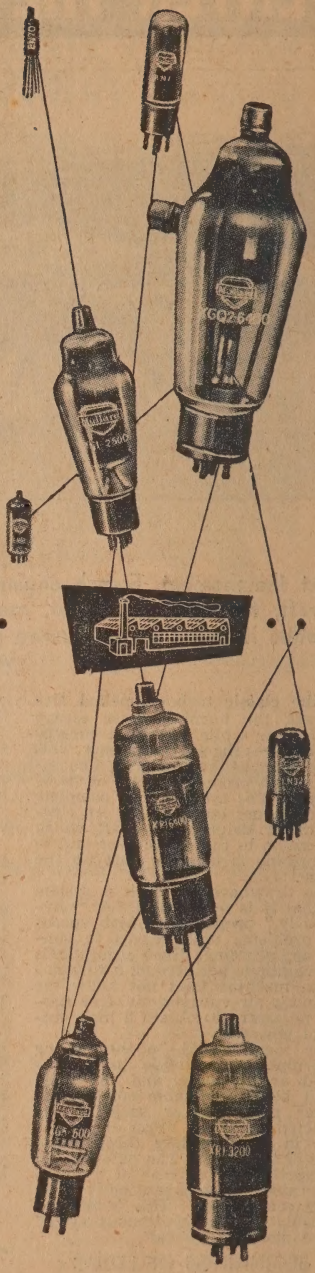

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EN32	—	CV2253	0.3
EN70	5643	CV474	0.03
EN91	2D21	CV797	0.1
XR1–3200	5544	CV2210	3.2
XR1–6400	5545	CV2215	6.4
XG1–2500	*57/5559	—	2.5
XG5–500	*17/5557	—	0.5
XGQ2–6400	*105	—	6.4

*Type No. usually prefaced by manufacturer's initials

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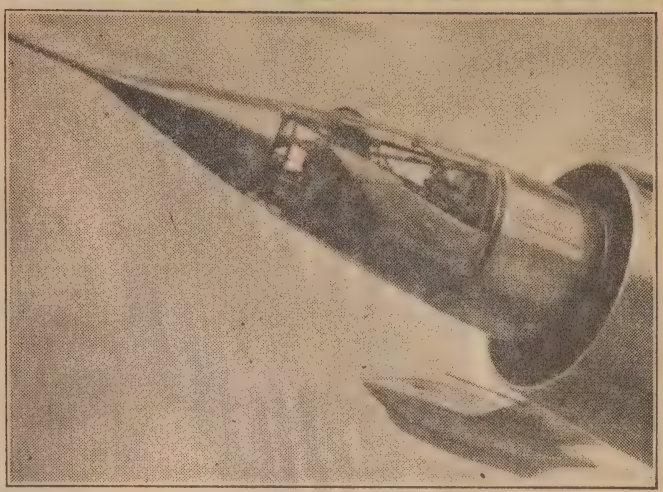
PROBE THRUSTING TO THE SKY



A close-up of the pointed nose and pilot's compartment of the Leduc 021.

the Leduc 0.21 which, with its ,000 hp propulsion, can climb at 0 metres a second. This fantastic gure, which corresponds to 0.84 ach (84 pc of the speed of sound) for low altitudes. It is still 20 to metres a second at 15,000 metres. hese performances, which recall ore those of a "V2" than those of a loted aircraft, attest to the exaordinary resources of thermo-jet rcraft.

HE 1955 PROTOTYPE

The prototypes of the L 0.21 were ctually flown on the 7th August, 953, and on the 21st of February, atapulted by "release".

The congenital weakness of the ato-jet aircraft is that it cannot ke off from the ground by its own eans. It is necessary for air to be rced into the propulsive diabolos order to obtain propulsion. This only possible at about 800 kiloeters an hour.

The operation is carried out in the llowing manner. The "stato" is ixed on to the back of the Languedoc by means of a bolt at the rear nd two swivel-joints in front. The ilot of the stato begins by withrawing the bolt at the rear, and nen the two pilots watch the teleadications of the two swivel-joints vhich are equipped with a dynaometer. They work their rudders n such a way that the strain is carefully equalised. At this moment the wo aircraft come apart. The tato effects its flight and lands on ts own landing-carriage.

The Leduc 0.22, which will be tried ut in 1955, possesses an arrow-like wing and can climb vertically at Mach 2, that is to say at twice the speed of sound. Its propulsive force of 60 tons will allow it to take turnings at 3G—an intensity of centrifugal force equal to three times its weight. The supply of fuel must be increased to 50,000 litres an hour, under pressure. In order to do this, it was necessary to perfect a force-pump weighing 10 kg—while the industrial model weighs a ton. This is a detail of its construction which, with many others, serves to relate the Leduc stato-jet aircraft to the most powerful rockets of the V2 type.

THE SUN AND ITS RAYS *(From page 7)*

Air molecules are very small, even n comparison with the short waveengths of the sun's light.

Another requirement for scatterng in a particular spectral range is, f course, that sufficient energy is present in the original radiation in hat range. As we know, the sun's adiation is (see fig. 2) strongest in he blue region.

Thus, as blue radiation is the lowst spectral range with sufficient inensity, this is predominantly scatered by air and water vapor molecules if the sky is clear and the ir relatively clean. The sky, therefore, appears as blue in color.

But dust particles can be much arger than the molecules, and the ight scattered by them shows a tenliency toward whiteness with an special increase in the red range. Thus, the sky appears less intensely blue above industrial and city areas han elsewhere.

RADIATION MEASUREMENTS

Since radiation research began, many instruments have been developed and readings have been taken in all parts of the world. However, much remains to be done.

Networks of radiation stations exist in many countries, and Australia has undoubtedly one of the most modern networks of the world. The centre is a meteorological radiation observatory, where all the work of design, development, calibration, and maintenance of the network instruments is taken care of in addition to evaluation of data and special research.

The Australian network instruments are of very simple design and operation—features regarded as impossible only a few years ago.

In fact, some of them are so straightforward that here may well be a new field for the keen hobbyist.

Radiation instruments can be classified in acocrdance with the purposes they serve.

And here we have the most important types of instruments: First, there are the so-called "Actinometers", which are instruments for the direct measurement of the sun's rays. No other radiation is allowed to fall on to the detector.

Next, we have "Pyranometers" for sun-plus-sky radiation.

Another important type is the "Pyrgeometer" for the measurement of sky and also temperature (long-wave) radiation. With this instrument, the sun must be screened off in order to allow careful measurement of these other radiation components.

It is also possible and often convenient to use recording instruments.

Some of the above instrument types can be connected to mechanical or electrical recorders. The very popular sunshine recorder, of which various types exist, is commonly utilised as an indicator of the duration of sunshine per day.

POWER SOURCE

For special research work in the field of meteorological radiation, special electronic equipment has been developed to bring us a step further toward the goal of knowing all problems related to these types of radiation.

Let's have another look at that solar constant: 1.1 kilowatts or 1.47 horsepower per square yard is the figure, and we have learned that about 25 pc is lost. This still leaves us with about 1.1 horsepower per square yard with full insulation!

It is definitely an amazing power source if we were only in a position to use it efficiently.

At present, the energy conversion efficiency of present solar powered equipment is so low that, so far, its use is not economical.

A thorough discussion of the problems involved would alone take the space of another article, and we shall, therefore, restrict these remarks to merely mentioning that there seem to be three fundamental categories of solar power "generators".

THREE CATEGORIES

There is, first of all, the purely electrical category, where detection is achieved by a thermo-electric or photo-electric device (thermopile, semi-conductor photo-electric cell, &c.).

Secondly, we have "generators" based upon the steam engine principle, e.g. driving an electric dynamo and thus charging batteries, say. This type could be called the indirect electric category.

This classification may be concluded by the non-electric type, i.e., using heat energy only. The well-known solar distillation in country areas is a good example of an already reasonably efficient use of solar energy.

CURRENT CLOSE-UP OF SCIENCE

Raindrops seldom fall in their classical pear-drop shape. They come in a variety of shapes and sizes, changing rapidly from one to the other many times a second as they fall through the air.

Raindrop Shapes

INFORMATION about these split-second changes in the raindrop is of more than academic interest. Meteorologists are making use of radar nowadays to follow rain formation in the upper air. And to understand the reflection of the radar waves, they must know something about the shapes and sizes of the raindrop.

A really big raindrop is often shaped like a flying saucer, with the rounded surface uppermost. As it falls through the air the raindrop saucer may spin like a top, then it begins to elongate into a dumb-bell shape and eventually splits into something like a caterpillar, with drops held together by thin strands of water.

Finally, the whole contraption breaks up into a lot of smaller drops.

Special wind-tunnels are used for studying the shapes and sizes of the raindrops. A jet of air blows upward, holding the raindrop almost stationary like a ping-pong ball on a jet of water.

High-speed cameras take photographs of it as it "falls" through the moving air.

Watery Cycles

Most of the water that reaches us so regularly as rain is merely taking part in an air-borne circular tour. It evaporates from the land and sea into the air, and then falls back again.

Then again it may be taken up by plants and fruits and find its way into wine or drinking water or any sort of fruits or vegetables.

There is always a small amount of water manufactured in the upper air from hydrogen and oxygen gases. Part of the hydrogen is in the form of the radioactive H-bomb ingredient tritium, which is generated by cosmic rays.

Every drop of rain that falls contains its quota of tritium, which is steadily decaying as it throws off sub-atomic particles. In 12½ years, half the tritium in any sample of rainwater will have disappeared, and these declining radioactive powers of rainwater with advancing age are being put to good use.

By measuring the radioactivity of water, we can now tell how long it is since it fell to earth as rain. We can check the age of vintage wines, for example, precisely and easily, by measuring the radioactivity of the water in them.

Measurements of the radioactivity of sea water have shown that rain mixes only to a depth of about 50 yards. The water in some deep wells, according to other measurements, has been underground for half a century.

"Chemical" Foods

The word chemical has a sinister reputation whenever it is used in connection with human food. Yet every type of food we eat is itself a chemical, made for the most part from the elements carbon, hydrogen, oxygen and nitrogen.

Arranged into suitable structures by the plant, the elements provide us with the carbohydrates, fats, proteins and vitamins we describe as food.

We do not shudder at the thought of eating the fat on a slice of beef; but we would think twice before tucking into a piece of glyceryl stearate.

One trouble with chemicals is that they tend, individually, to have these forbidding names. And it sounds like suicide to eat them.

There is no guarantee that a food is wholesome simply because Nature herself has made it. Some toadstools are far from good foods. And even such common foods as cabbages and turnips, raw eggs, shellfish, some types of peas and beans can be charged with potentially harmful substances, all produced quite naturally.

By J. GORDON COOK, BSc., PhD.

The fact is that as civilisation has developed, man has had to indulge more and more in processing his food.

First, for example, he started to cook it—a thoroughly unnatural procedure. He found that chemicals like sodium choride—common salt—could improve the flavor, and could help to preserve the food. Then he started smoking his foods to tide him over the lean season.

There are few foods more highly charged with chemicals than what we call a "naturally smoked" kipper.

Most substances added to foods or used to create synthetic foods are well and truly tried out and scientists are as certain as can be that they are doing no harm.

The danger lies, of course, in using chemicals in food before being reasonably certain that they are not going to be bad for us. Nobody can ever be absolutely sure that a substance is entirely harmless; even common salt can be dangerous if we get too much.

Windmills and Smog

For millions of years, Nature has been controlling the movement of air over the earth's surface. She has decided which way our winds should blow, and how fast.

But now, with the help of his modern aerodynamic techniques, man is beginning to turn the tables. We are learning how to make the air move in the direction we want it to go—to modify our local weather.

Giant propellers mounted on 30ft towers are keeping frost from California fruit groves. In New Jersey, an experimental windmill is drawing down more than 1-million cubic feet an hour of warm upper air, and using it to keep frost and fog from the highway.

Recently, Dr. Werner Spilger suggested to the American Meteorological Society that huge windmills could be used effectively for dispensing smog over cities or bringing rain to desert regions.

GOOD PICTURES FROM BAD PRINTS

SCIENTISTS at the U.S. national bureau of standards, the government's central laboratory, have come up with something millions of camera fans whose enthusiam outruns their skill may come to love—a device for making good pictures out of bad ones.

The U.S. bureau of standards described the basic process in its technical news bulletin as "electro-optical image processing." For the uninitiated to whom that might not be perfectly plain, the bureau also described it as a system that will facilitate the study of visual perception and recognition of patterns.

This all adds up to the following:

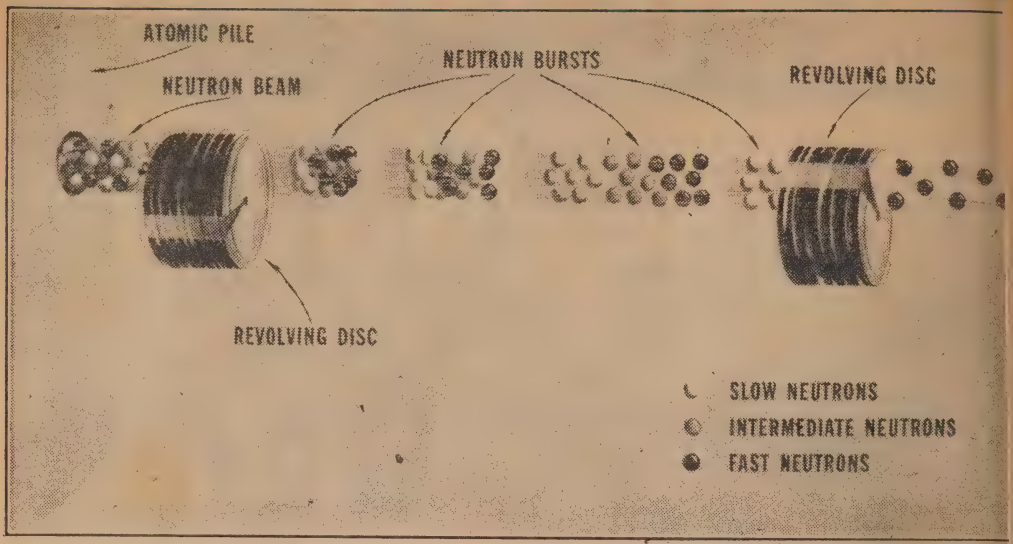
Say you have a photo of your latest family gathering (or of an enemy industrial site you want to bomb) that is dim and fuzzy. You take the negative and set it up in the view of an electronic scanning tube, much like the picture tube of a television set. This scanning tube examines the negative much more sensitively than is possible for the human eye. It discerns difference of light and shade that the eye cannot make out.

Thus, it sharpens up the picture, making lines and sharp light and shadow areas out of what the eye could see only as fuzzy, undefined areas.

In the final analysis, you can take a new photo of the sharpened image as it appears on the face of a viewing tube and, presto!—you have made a good picture out of a bad one.

Also, by a change in the circuit and scanning, the device will convert a photograph into a line drawing.

The equipment may soon be used to clarify finger prints, photos of germs etc. and crystal formations.



Simple but ingenious is this "neutron chopper" which is used to isolate groups of neutrons travelling at different velocities. Each of the whirling discs has several radial slots, not just one as shown in the sketch.

NEUTRON IS KEY TO THE ATOM

Of all the fundamental particles of nature involved in the structure of atoms, the neutron is perhaps the most useful to man for the production of atomic energy.

SO much has been written about atoms that it seems difficult to single out any one particular aspect that has not been fully covered before.

There is much about the peculiar properties of the neutron and the methods used in its separation and detection that is available only in scientific journals and therefore out of reach of the average reader.

It is proposed here to summarise the scientific findings and experiments of this most interesting unit of matter.

The atom is an entity of extremely tiny proportions, yet it is so heavily "armed" against outside attack as to make it almost invulnerable.

Logically speaking, that is as it should be, for the reason that all matter in the universe consists of atoms. If the atom were too vulnerable to destruction, the universe would be a vast conflagration "without form and void", to use a Bible term.

FABULOUS NUMBERS

It has been estimated that about one hundred billion billion atoms are contained in the head of a pin, yet the central core of the atom—the nucleus—is about ten thousand times smaller than the atom itself.

Such tiny measurements are almost beyond human conception, yet it is with such small particles that scientists deal when creating atom bombs or generating atomic energy.

For its size, the nucleus of an atom is extremely heavy. So heavy, in fact, that if a piece of matter the size of a toy marble consisted solely of nuclear material, it would weigh more than 200-million tons.

The most universally used method of finding out about the nucleus of atoms is to bombard the atom with various types of particles. This is done in enormous machines which accelerate particles and guide them to a target which they hit with extreme velocity.

The target may be a piece of any substance. The bombardment is so powerful that the atoms of the substance are distintegrated by the high-speed particles entering the nucleus.

Such machines are called cyclotrons, Vevatrons, electrostatic generators, and so on.

by Calvin Walters

The main nuclear particles dealt with by scientists can be listed as follows:—

PROTON: This is the nucleus of an atom of hydrogen. It is positively charged and so tiny that if you multiply 10 by itself 26 times, then multiply the result by 2.72, you will calculate the number of these protons required to make a lb.

NEUTRON: This particle has no charge whatever, and weighs about the same as a proton.

POSITRON: This has a positive charge of electricity. When it encounters an electron it dissipates itself in a flash of radiation and disappears together with the electron.

The other particles are the beta particle, nucleon, meson gamma rays and neutrino.

DISCOVERED 1932

The Neutron was not observed until 1932, although its existence was suspected by Rutherford as early as 1920.

When the metal beryllium is excited by the radiation from the natural radioactive element polonium, neutrons are generated by the disintegration of the beryllium.

It was the discovery of the neutron which brought about the development of atomic energy.

Rutherford, in his Bakerian lecture in 1920, said, "Such an atom

. . should be able to move freely rough matter . . . and may be mpossible to contain in a sealed essel."

Although Rutherford summed the natter up fairly well about the be- avior of a neutron, if it could be ound, it was not until 1932 that his rediction was fulfilled.

The neutron then is an uncharged r neutral particle with about the ame weight as a proton.

Being an uncharged particle, it is ifficult to control because it is un- nfluenced by electrical or magnetic ields. It cannot therefore be slowed lown or accelerated by electrical or nagnetic means, and the only way o change its direction and motion is y collisions with other particles.

It is very penetrating, and only very thick barriers will stop it. At slower speeds it is readily captured by the metal cadmium and boron. It has a half-life of only 30 minutes.

HOW PRODUCED

The production of neutrons is by the bombardment of beryllium with rays from radium and in a nuclear fission reactor.

The two most important facts learned about the neutron and which brought about the development of atomic energy were these:

Firstly, any neutron which had the same energy as the surrounding atoms would penetrate and split the nucleus of the all-important uranium 235 atom, with a resultant release of energy.

The second point was that it was thought that, when the uranium was split, it would release from its nucleus two or three more neutrons and that these, in turn, would split more uranium nuclei and so on. This is the famous chain reaction.

This was found to be true and, in a large block of uranium, each atom emits two neutrons and each of these in turn causes another fission, the chain reaction growing with a multiplication of two.

CONTROL SYSTEM

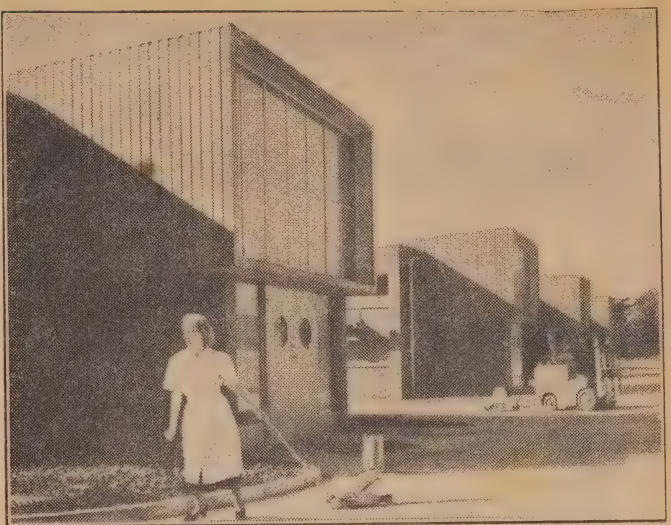
Thus the original fission causes two; these two cause four, then 8, 16, 32 and so on. The tenth would give 1024 fissions, the 20th over a million. The 90th would cause a billion-billion-billion fissions, each requiring only a millionth of a second to occur, so that 90 generations of fissions would require only about one 10,000th of a second to produce a billion-billion-billion atomic fissions.

These figures are fantastic and can only be visualised by the results attained in the atom-bomb.

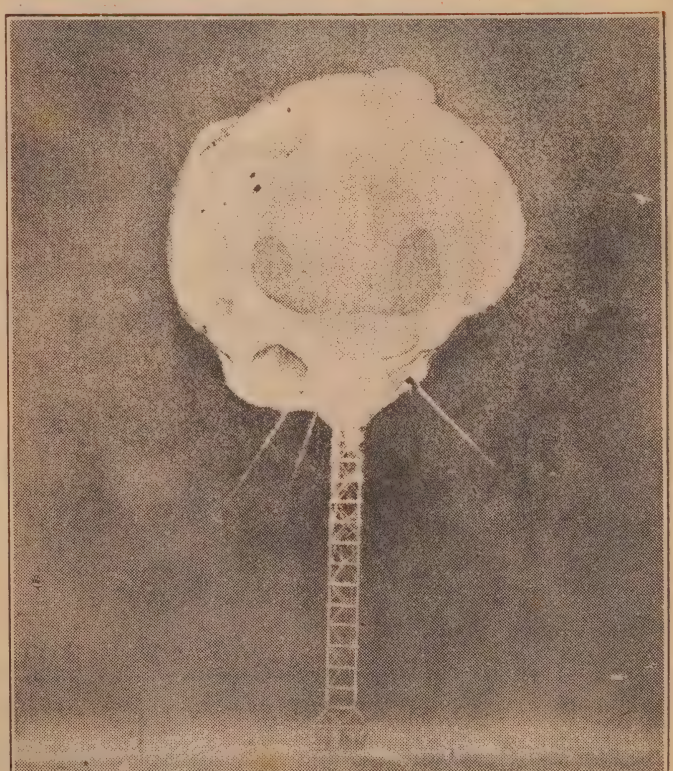
The production of neutrons in a nuclear reactor are rigidly controlled however, so that there is a constant generation of constant power.

This is done by inserting boron rods in the atomic pile which absorb some of the excess neutrons. Other neutrons are used up in the manufacture of plutonium and for making radio-active isotopes.

The main reason for the usefulness of the neutron in atomic fission is that owing to the neutral character of the particle, it propels itself at great speeds through the magnetic fields surrounding the atomic nucleus without being affected or "deToured" by these fields. Thus with a speed critical to the nucleus of the



Atomic research turned to peaceful ends. The heavily shielded container, being wheeled along by an assistant at Britain's Amersham centre, contains radio-active isotopes ready for export. They are used for medical and industrial purposes.



The other side of the picture—atoms for war. This remarkable picture, taken at one millionth of a seconds's exposure shows an atomic explosion dirintigrating a rteel tower at the U.S. Atomic Engergy Commission's Nevada proving ground. Because of the terrific glare, the picture was over-exposed, necessitating special reprinting

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atom, it will penetrate right to the heart of the nucleus and split it.

The neutrons generated in an atomic reactor have a very wide range of speed energies. In order to carry out research into the effects of selected energies a clever device is used called the Argonne "neutron chopper" which sorts the neutrons according to their energies.

The concrete shield surrounding a nuclear reactor is furnished with an opening through which stream neutrons of all energies. It is necessary for research to separate from the mixed lot of neutrons those which have the same energies and called "mono-energetic".

The "chopper" consists of a "disc" of high-grade steel 4in in diameter and 16in thick. Six slits are cut in the disc from end to end. The disc is revolved at a speed of 40,000 revolutions a minute by means of a 3 hp electric motor. This thick disc stops all but the most penetrating neutrons.

At a distance from this disc on the same shaft is another and similar disc.

PASSES THROUGH SLOT

The stream of neutrons emerging from the window in the concrete wall meets the first revolving disc which actually has six radial slots, not just one, as in the illustration.

The whirling disc blocks some of the neutrons but allows others to pass in groups through the open sectors. As these groups emerge from the slots, they tend to break up, the faster moving neutrons naturally taking the lead over the slower ones.

The second disc can then be timed to chop off only those neutrons with the fastest speeds, or, in fact, any group of identical speed.

Another instrument does a similar thing in a different way. It chops off the groups of neutrons, but a system of electronic detectors times the arrival of each group.

Again, the groups may be separated by means of certain crystals which reflect at different angles groups of neutrons at different speeds. Thus the neutrons are spread out in a similar way that a glass prism spreads out the colors in the light spectrum.

Neutrons may also be captured in cadmium containers. These are made of such a thickness that only the fastest neutrons will pass through. The rest are captured in the cadmium.

The energy of a neutron is calculated in micro electron volts. It is sufficient to explain this by saying that a neutron with energy of one MEV travels at about 30,000 miles a second. Most neutrons average energies of two to three MEV, but greater speeds are sometimes attained. But speed is not the only characteristic of the neutron.

TWO POLES

Like other particles, it spins on its axis like the earth, and possesses a north and south pole. However, the axes of neutrons in a beam are tilted in all directions.

Means have been found for having the axes of all neutrons in a beam tilted in the same direction.

This is done by directing the beam of neutrons on to a polished and magnetised cobalt mirror tilted slightly from the vertical.

RECEIVER OPERATED BY LIGHT

This German radio set operates from light. Even a lamp shining on selenium cells in the folding back will generate enough power for signals to be heard, and the set will work on the light from an ordinary electric torch. It is equally effective in daylight.

When the neutrons are reflected from this they are all tilted in the same direction. They are polarised.

These polarised neutrons are useful for determining the magnetic property of steel by finding how the axis of a polarised neutron is tilted after bouncing off a sample of the material.

Being electrically neutral, neutrons cannot be counted in a Geiger counter. However, the introduction into the tube of suitable gases, such as boron trifluoride, renders the counter capable of actuation.

As the neutrons enter the atoms of the gas, charged particles are given off from the gas, which can be counted.

Much time and energy has been expended in developing instruments which will accurately count neutrons. This is all-important in a science which deals so exhaustively with numbers. For instance, when a beam of neutrons is directed on to a material, it is generally important for the success of the experiment to know how many neutrons were absorbed and how many went through.

One technique has been developed for computing how many neutrons are absorbed by any specimen.

An atomic reactor is always set to a level of operation according to the number of neutrons generated inside it. It has been found that if the specimen is regularly oscillated in and out of the neutron field in the reactor, the entire operation level of the reactor is affected according to the number of neutrons "stolen" from it by the specimen.

By this method the number of neutrons absorbed by the specimen can be computed according to the magnitude of the disturbance of the operation of the reactor.

It is necessary to be able to measure the angles at which neutrons are deflected from target materials.

This is done by means of a "parallel plate" counter. It consists of two parallel plates, one of glass and the other coated with the metal iridium. When the neutrons pass from the target into the space between the two plates the indium plate emits particles called beta particles, for some time afterward. These produce visible sparks and are photographed. The picture then shows where the neutrons hit the plate, and from this the angle is calculated.

When the nucleus of an atom has captured a neutron it becomes possessed of excess energy. Many of the new nuclei get rid of this excess energy immediately by violent radiation in the form of gamma rays. Others remain unstable for wide periods of time, while emitting various rays, such as gamma rays and alpha and beta particles until they finally decay into more stable states.

These are the important artificially induced radioactive isotopes which play a very important part today in medicine, agriculture, industry and so on.

Much more could be said about this important particle, the neutron, but space does not permit. Enough has been said, however, to give some idea of the way this particle behaves. The particle is the subject of ceaseless research and no doubt its value in the future in the production of atomic energy for peaceful purposes will be incalculable.

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Technical Review

SURGERY IS SAFER WITH NEW AUTOMATIC MONITOR

An electronic instrument which atuomatically detects changes in the physiological condition of a patient under anesthesia throughout the course of an operation has been developed by the National Bureau of Standards working under sponsorship of the Veterans' Administration.

KNOWN as the NBS Physiological Monitor, this instrument measures changes in the patient's blood pressure, heartbeat, and respiration as they occur, and presents the data on a panel for interpretation by the surgeon or anaesthesiologist.

A permanent record of the patient's condition during the operation is also provided.

The instrument should prove of great value in the prevention and control of emergencies which may unexpectedly confront the surgeon at the operating table or during certain critical postoperative periods.

AID IN RESEARCH

It is also expected to be a distinct aid in those phases of medical research—such as studies of the effect of drugs on blood pressure—that require a knowledge of the behavior of physiological variables over long periods.

During surgery it is vital that the condition of the patient be known at all times. Ordinarily the anaesthesiologist measures blood pressure and pulse rate at sufficiently close intervals to maintain a satisfactory evaluation of the patient's condition. If necessary, he administers drugs, additional anaesthetics, or infusions of blood or plasma.

However, when the anaesthesiologist is occupied with his other duties, longer periods may elapse between measurements.

Although in most cases this delay is not serious, at other times it can result in unfortunate consequences.

For example, when complete circulatory collapse occurs—as in severe blood loss or in heart failure—there may be some lapse of time before the condition becomes outwardly apparent.

Since time is important in applying remedial measures, the earliest possible detection of such a crisis offers the best hope in saving the life of the patient.

The NBS Physiological Monitor makes prompt emergency action possible by continuously displaying the information the anaesthesiologist needs to know in simple, numerical form.

Data on systolic and diastolic blood pressure, pulse rate and pulse irregularity, breathing rate, and amount of air breathed out per minute, are available at a glance. Preliminary adjustments are easily made, requiring no special technical training on the part of the operator.

Safeguards are provided to permit the instrument's use in the highly combustible mixtures of anaesthetic gases that are usually present in the operating room. Size and weight have been minimised for easy moving, and the amount of floor space required has been kept as small as possible.

While individual systems were already in existence for performing some of the functions of the Physiological Monitor, for other functions it was necessary to develop entirely new methods of approach.

GENERAL PROBLEM

In general, the problem was to integrate the various component measuring and indicating systems into a complete instrument which would function smoothly and safely in the operating room and which would present results in a clear, easily interpreted manner.

The automatic system used in the Physiological Monitor for measuring blood pressure is based upon the technique commonly used by an examining physician.

The physician forces air into a hollow band, or cuff, surrounding the arm until the systolic pressure is exceeded; he then gradually reduces the pressure and determines systolic and diastolic pressures by noting the pressure reading on a manometer when certain characteristic pulse sounds in the artery are detected with a stethoscope.

In the automatic system, a microphone is located at the point of observation over the brachial artery. Every three minutes the valve of an air supply automatically opens, allowing the pressure within the arm-band to increase.

As soon as the pressure in the band exceeds the diastolic value, the microphone begins to pick up sound within the artery. This sound reaches a maximum and decreases, disappearing after the pressure in the band exceeds the systolic point.

By means of a system of amplifiers and relays, the pulses picked up in the microphone actuate two solenoid valves in the air system which open to connect the system to the proper pressure indicating gauges at the diastolic and systolic points.

The valves close almost immediately after opening so that the diastolic and systolic pressures — now converted by a transducer to electrical signals — remain registered on the indicating meters until the next measurement cycle begins.

The amplifier and relay circuit are arranged in such a way that when the microphone receives the initial sound from the artery, the first valve opens, permitting the adjacent gauge to register the diastolic pressure.

Since it is not possible to determine the point at which sound disappears until that point has been passed, the pressure is now carried beyond the systolic point and then allowed to decrease slowly until the systolic pressure is again reached.

As the first sounds corresponding to the systolic pressure are received, the second valve opens, allowing its adjacent gauge to "capture and retain the instantaneous pressure of the system.

The band is then rapidly deflated to minimise the period during which pressure is applied to the patient's arm.

The system for discrimination between the sound pulses produced within the artery and other noise signals is based upon the fact that the sounds within the artery are accompanied by corresponding slight increases in pressure within the arm band. The coincidence circuits reject all sound pulses that do not coincide with the necessary pressure pulses.

FURTHER PROTECTION

As a further protection, these circuits prevent actuation of the relay system by any sound pulse that is not followed by a similar pulse within one-half second.

The blood pressure measurement system has been used on many different human subjects for periods ranging from an hour to as long as 21 hours under hospital conditions.

In general, it appears to cause the patients no discomfort and permits them to eat, sleep and carry on other activities of a bed patient. Good agreement has been found between instrument values of blood pressure and those obtained in the usual way.

From U.S. National Bureau of Standards Technical News Bulletin (Aug. 1954).

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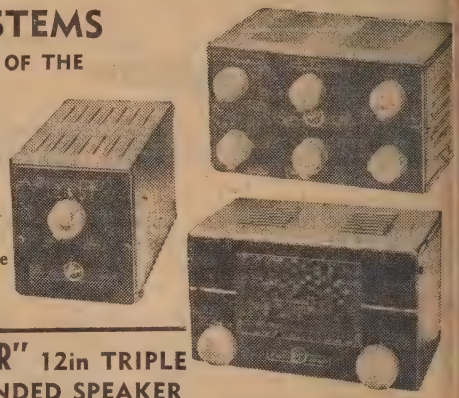

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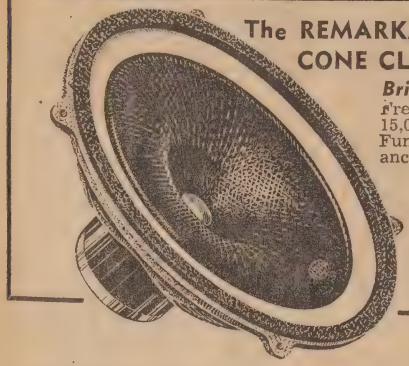

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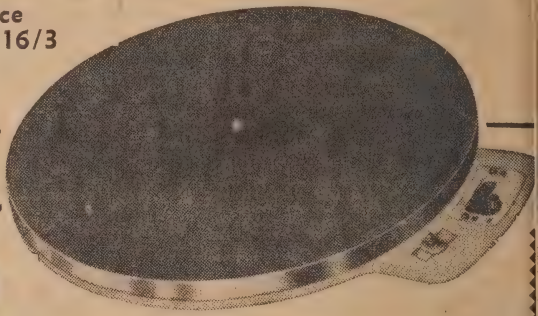

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Changes in pressure following the administration of drugs affecting blood pressure are easily followed.

It is important to monitor the pulse rate during anaesthesia, since the action of some of the anesthetic drugs and the effect of surgery tend to increase cardiac irritability.

While the physician ordinarily checks heart beat, or pulse rate, by counting the pulsations of an external artery, an alternative method obtains the information by measuring the periodic changes in the very small voltage produced by the heart.

TIME MEASURE

Electrical connections are made to the patient's arms and legs as in the use of the electrocardiograph for study of heart conditions.

By means of suitable circuitry, the time between adjacent pulses in the cardiac potential is continuously measured and converted to rate on a specially calibrated meter. Thus the instantaneous heart rate is measured, rather than the average rate over a given period.

This makes it possible to follow irregularities and abrupt changes in heart beat.

An indicator lamp flashes in synchronism with the pulse, providing a convenient means for obtaining the patient's pulse rate by the conventional method if desired.

Once the electrodes are adjusted, the operator has only to read the values of pulse rate from the dial. Continuous measurements have been made on medical ward patients for as long as 21 hours without difficulty.

Arrhythmia, or cardiac irregularity, may be the forerunner of serious difficulties for the patient in the operating room. However, objective measurement of arrhythmia is complicated by the fact that both changes in rate and occasional irregular beats occur under normal as well as abnormal conditions.

The system developed by the bureau was therefore designed to weigh the rate of occurrence of such "arrhythmic incidents" rather than to indicate these events individually.

Time differences of 25 pc are arbitrarily defined as arrhythmic incidents. The circuit gives the average time rate of these occurrences and presents it on an arbitrary scale.

The measurement is accomplished by an extension of the circuitry that measures pulse rate.

CHARGING PULSE

When the heart beats are uniformly spaced, electrical charges flow into a storage or "memory" capacitor, that discharges at a regular rate. When the heart beats occur at too frequent or too rare intervals, the charging pulse into the storage capacitor assumes abnormal proportions, indicating an "incident".

For purposes of studying the system's response to arrhythmia, a circuit is also included which turns on an electrocardiograph whenever unusual irregularity of the heart beat is indicated.

While measurements of respiratory function are not ordinarily available during an operation, such information should be of considerable value.

Under general anaesthesia, those parts of the brain which normally control respiration become depressed to an extent depending on the depth of anaesthesia.

Also some surgical procedures are accompanied by mechanical impediments to breathing.

Development of a system for obtaining information on respiration and volume should permit the routine application of these measurements during surgery and should also provide a means for determining their value to the anaesthesiologist.

The basis of measuring equipment in the Physiological Monitor is a positive displacement flowmeter in which the rotation of the output shaft is proportional to the volume of gas that has passed through the meter.

A mechanical linkage and storage system presents on a dial a suitable reading for respiration volume, as measured over the preceding minute. The reading is brought up to date at one-minute intervals.

Respiration rate is determined as the number of times the shaft of the flowmeter starts and stops within a given time, as the patient breathes in and out. Each respiration pulse within the space of a minute is counted on a stepped counter, whose shaft assumes a certain rotational position, according to the number of registrations.

An indicator registers the breathing rate for the previous minute, while a new count is being made. As soon as this count is complete, the registering indicator assumes the new and appropriate reading.

Common use of explosive gas mixtures for anaesthesia makes it necessary that potential ignition sources for the gas be supplied with safeguards to prevent occurrence or propagation of explosions.

The electrical equipment in the operating room console contains voltage sources, contactors, motors, and numerous hot filaments, all of which could serve as sources of ignition under certain conditions.

Equally important as ignition sources are possible static charge accumulations on surfaces of the equipment and accidental connection of the instrument housing or any of its parts to the power line through insulation failure.

To prevent accumulation of static charges, the operating room console is equipped with conductive rubber casters grounded to the metal frame.

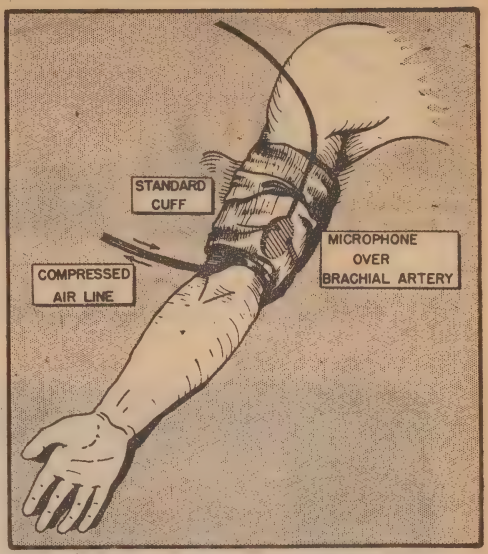
However, the use of explosion-proof fixtures, as in fixed electrical installations did not appear feasible for portable equipment of this size. Instead a system based on the maintenance of a small positive pressure within the enclosure was designed.

Safeguards are provided which prevent the application of any power to the equipment unless the purging pressure has been applied for a period of not less than two minutes.

To ensure the safety of the patient against possible short circuits or other electrical hazard, the electrodes for measuring heart beat are so designed that high ohm resistors can be placed in series with each one of them.

Safety precautions have also been incorporated in the blood pressure measuring device to guard against the application of excessive pressure to the arm of the patient or, worse, the maintenance of occluding pressure for long periods.

HOW BLOOD PRESSURE IS TESTED



Artist's drawing of a patient's arm showing the attachments for measurement of blood pressure. A hollow cuff surrounding the arm is inflated automatically at intervals from an external air source. A microphone is located over the brachial artery to detect sound pulses. These sound pulses are amplified by an electronic circuit and made to actuate a valve and gauge device which indicates and records the pressure in the system at the time it is equal to the patient's blood pressure.

ONE of the very oldest of industrial processes has been revived for aircraft work with the use of "barrelling" for aircraft parts—rotating them in a barrel to give a smooth finish and "knock off the corners".

Various forms of barrelling have been used in other industries—for instance, in the production of ball-bearings—but to get the extremely accurate finish required for aircraft parts, manufacturers in the past have insisted on hand finishing each part individually.

Now it has been found possible to get excellent results by barrelling such parts as structural members for jet fighters and turbine blades for jet engines. Aircraft constructors have been able to get surface-finishes as fine as 7 to 10 micro-inches as a matter of routine. The switch-over to this old process has produced remarkable saving in cost, time and manpower.

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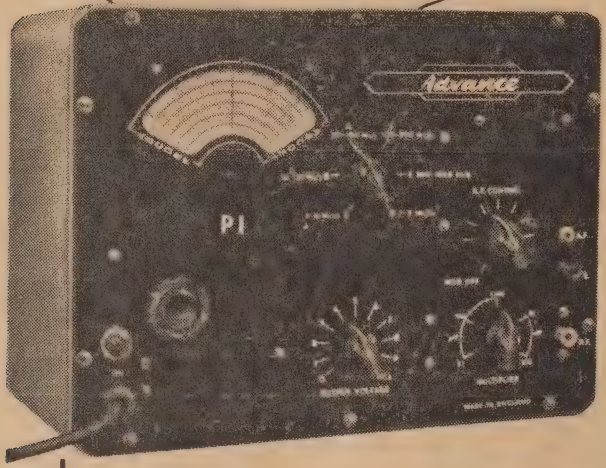

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The P1 employs an accurate attenuator system which embodies a non-inductive slide-wire followed by a five-position 75-ohm ladder network. The 75-ohm cable, correctly terminated by the "Advance" TP8 pad, obviates reflections due to mis-match and ensures that the output voltage at the dummy aerial is substantially that indicated by the attenuators.

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RENEWED INTEREST IN THE ELECTROSTATIC SPEAKERS

The problem of producing a wide-range speaker system is not an easy one and it is generally found that price rises steeply with performance. Some designers believe, however, that the electrostatic speaker may solve the problem at the high frequency end, because it offers good dispersion of sound, wide range, low distortion and simplicity of manufacture.

ELECTROSTATIC speakers have been released both in the US and on the Continent. Lack of sensitivity, as compared with modern moving coil types, appears to be their greatest limitation.

The following is an extract from a recent article in "Electronics" by Marvin Hobbs, describing a new American speaker:

The speaker consists of a stiff, curved, perforated, copper-backed plate, mounted in a molded-plastic housing with a gold-sprayed, insulated foil tensely stretched over it. The sieve-like copper plate serves as one electrode and the gold film serves as the other.

A LARGE CAPACITOR

The electrodes and insulating foil form a capacitor of approximately 4000 uuf. The gold electrode, which is at the front of the speaker, is at ground potential and is protected by a thin wide-mesh cloth covering. Acoustical reproduction results from the forces established in the dielectric due to the variations of potential between the plates.

Early models of electrostatic speakers had two major disadvantages: sufficient movement to reproduce the full audible-frequency range at any reasonable power level could not be attained without high driving power and a high polarizing potential; physical propertes of dielectric materials were such that voltage breakdown was a common occurrence.

The first problem is solved by confining operation to the approximate range of 7000 to 15,000 cycles. This keeps the energy content of the signals fed to the speaker at a low level, eliminating the requirements for a large movement of the diaphragm.

Thus, both the driving voltage and the polarizing potential are kept within the bounds of values available in an inexpensive amplifier. In the same way, the problem of voltage breakdown is minimised.

BREAKDOWN VOLTAGE

An additional safety factor is provided through the use of Styroflex or polyethylene dielectrics giving a unit having a breakdown limit of 1000 volts; which is four times the average polarizing potential of 250 volts required.

The electrostatic speaker is a voltage-operated device. To handle any given value of AC input voltage, it is recommended that a DC polarization potential of twice the value of the highest value of peak AC modulation voltage occurring in practical use be applied to the unit in conjunction with the audio voltage.

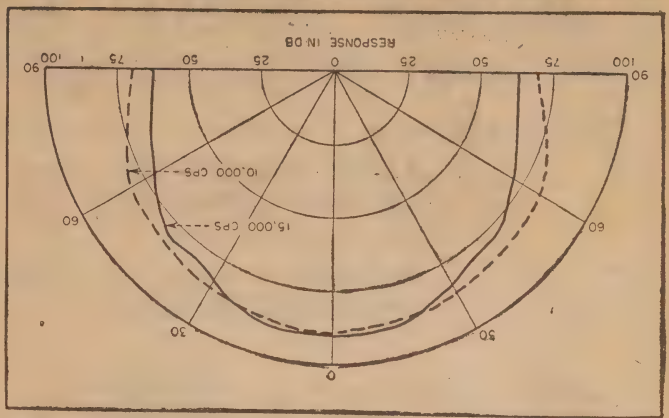

Figure 1: The horizontal polar diagram of an electrostatic speaker having a curved diaphragm. In the vertical plane, the polar angle is approximately 30 degrees.

A polarizing potential of plus 250 volts is a typical value. However, the speaker can handle an audio input voltage up to a maximum of 150 volts peak.

Potentials of 250 to 300 volts are readily obtainable from the B-plus supply of most audio amplifiers.

The relationship between the speaker input and output at 12,000 cycles is such that a low level of distortion will be realised. The response curve throughout the range of 7000 to 15,000 cycles is relatively free of peaks and quite uniform throughout the upper register.

Most past designs of electrostatic speakers utilised flat electrodes. Such configurations when driven by higher audio frequencies usually produced a concentrated pattern of radiated energy and was not the most suitable for covering more than a very limited angle directly in front of the unit. A speaker curved in the horizontal plane can provide a wider distribution of higher audio frequencies.

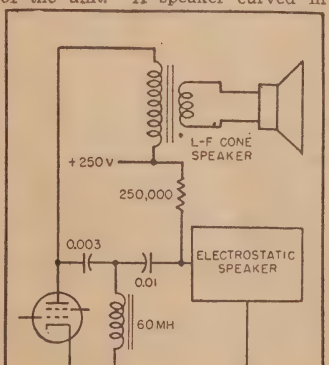

Figure 2: A typical circuit arrangement showing how the electrostatic speaker is fed from the output plate circuit. It is claimed that a cheaper output transformer design is possible because leakage inductance does not prejudice the high frequency output from the system.

Figure 1 shows the speaker's polar pattern in the horizontal plane at 12,000 and 15,000 cycles.

Although the pattern is somewhat restricted in the vertical plane (30 degrees at 12,000 cycles), the speaker is usually at such a level in a table model radio that the pattern covers the listener quite well, particularly when seated.

In console models where the cabinet design requires that the speaker be located below the ear level of the seated listener, the tweeter may be tilted upward.

A typical audio-amplifier output circuit for driving the electrostatic speaker in conjunction with a standard low-impedance cone speaker is shown is Fig. 2. The circuit for a push-pull output stage utilises component values similar to those of a single-ended output stage. However, the network feeding the tweeter is connected across only one-half of the output-transformer primary in the push-pull case.

COMPENSATION

The loss in high-frequency drive by this arrangement is adjusted by increased high-frequency compensation within the amplifier or by using a less efficient cone speaker to achieve the required tonal balance between highs and lows.

In either case the electrostatic speaker is fed through a low-cost network, consisting of 0.003-uf and 0.01uf capacitors and a 60-millihenry inductance. This circuit attenuates the audio voltages below 7000 cycles, with the shunt inductance keeping the impedance high in the operating range of the speaker.

An even simpler coupling network is sometimes employed, using only resistors and a coupling capacitor.

An interesting aspect of the circuit is that it permits a cheaper design of output transformer to be used. It is no longer necessary to design the transformer so that it passes both ends of the spectrum, since the tweeter is fed from the primary side.

High frequency loss in the transformer actually helps by giving an artificial cross-over effect.

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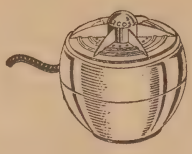

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MIC.3-2	General Purpose	1⅜in dia. x ⅜in thick	20db Peak at 2500 C.P.S.	Mona	£1 19 3
MIC.3-5	„ „	„ „ „ „ „	12db „ „ „ „	Mervyn	1 19 3
MIC.3-6	„ „	„ „ „ „ „	5db „ „ „ „	Myrtle	1 19 3

MIC. 6 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.6-4	General Purpose	2 1-32in dia. x 19-32 thick	20db Peak at 2250 C.P.S.	Margie	£1 19 3
MIC.6-6	„ „	„ „ „ „ „	5db „ „ „ „	Maudie	1 19 3
MIC.6-11	„ „	„ „ „ „ „	12db „ „ „ „	Mandy	1 19 3

MIC. 14 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.14-5	General Purpose	1 7-16in dia. x 11-32in thick	20db Peak at 3500 C.P.S.	Maxie	£1 19 6
MIC.14-11	„ „	„ „ „ „ „	12db „ „ „ „	Mitchell	1 19 6
MIC.14-12	„ „	„ „ „ „ „	5db „ „ „ „	Malcolm	1 19 6
MIC.15	Hearing Aid	0.9in dia. x 0.155in thick	30db „ „ 3000 „	Marlene	1 19 6
MIC.17	„ „	15-16 in sq. x 7-32in thick	30db „ „ 3500 „	Maggie	1 19 6
MIC.18	General Purpose	1 7-16 in dia. x 9-32in thick	20db „ „ „ „	Maisie	1 19 6
MIC.19-4	„ „	1 ¾in dia x 13-32in thick	Flat from 40 to 6000 CPS	Merry	1 19 6

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TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.23	General Purpose	1 3-16 sq. x ¼in thick	20db Peak at 3000 C.P.S.	Maureen	£1 19 3
MIC.23-3	„ „	„ „ „ „ „	5db „ „ „ „	Margaret	1 19 3
MIC.23-4	„ „	„ „ „ „ „	12db „ „ „ „	Milton	1 19 3
MIC.32	High Quality	1 13-16 dia. x 9-16in thick		Martin	2 15 6

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NEWS AND VIEWS OF THE MONTH

Ghost "guide"

THE castle of Langeais, one of the famous Chateaux de la Loire, is the first to install a "ghost" guide. By a system of loudspeakers discreetly placed in following rooms, visitors are invited to follow the "voice". As attention is called to different objects of interest, lights flash on to show them to better advantage.

The system is worked by a pre-recorded tape, which at the same time releases the lighting effects at the appropriate moment. It is possible to guide through the 12 rooms of the castle four groups at a time of 50 visitors, with an interval of five minutes between groups.

One recording of the "ghost" guide is in English for the benefit of Anglo-Saxon visitors.

"Ghost" guides are said to be planned for some of the exhibits at next year's Foire de Paris, guiding the attention of visitors to different new points in machinery and appliances.

Atomic waste

WASTE materials from Australia's first atomic reactor would not harm any form of life according to Mr. Beale, Minister for Supply. He was commenting on a report that the effluent from the reactor would kill oyster beds.

Mr. Beale said, "This report is completely false.

"We have not yet finally decided the site.

"But wherever it is the effluent will not cause damage to any form of life.

"The best proof of this is that the great atomic reactor at Harwell, near London, discharges its effluent into

predicted because of various fac- the Thames."

Atomic sub

THE world's first atom-powered submarine, the US Navy's Nautilus, has successfully undergone surface trials.

She has returned to Groton (Connecticut), the port where she was built.

On her maiden voyage, Nautilus sailed 50 hours in Long Island Sound.

The Atlantic "Submarine Force Commander (Rear-Admiral Watkins) said that Nautilus had been successful in her trials.

A Navy statement said, "The trials are continuing.

"But the exact time of beginning the submerged operations cannot be predicted because of various factors."

Sirens from ships in port welcomed Nautilus as she silently made her way up the channel home at low speed.

Jap radio

JAPANESE interests are seeking US aid in the construction of a huge microwave radio system.

The system would cost about 500-million dollars (about £A223,264,285).

The system would give Japan a virtual monopoly of the most modern communication service in South-east Asia.

It would involve the installation of microwave equipment at central stations in Japan for "facsimile" communication.

The radio system also would require the erection of hundreds of relay masts extending from Japan through the Philippines and along an are reaching to Karachi.

Australia, Hongkong and Singapore would be able to hook up to the system if they desired.

The microwave system would incorporate ground-to-air telephone communication and all telegraphic, photographic, radio and television services.

Atom "guard" beam

"ATOMIC BEAMS" so sensitive they ring fire-alarms if anyone lights a cigarette near them, are guarding Britain's radar defences from sabotage or fire.

Every radar set in the anti-aircraft defence network has these atomic fire-detectors — some no bigger than a hand torch.

Even a puff of smoke will set them ringing.

The detectors are plastic containers within which radium generates a continuous beam of atomic particles.

An alarm bell rings if this beam is interrupted by even a trace of smoke and long before any heat can get a hold.

The radium will generate the beam for 1600 years without maintenance or attention.

Cables for TV?

EXPERTS believe that, although it is not at present technically feasible, a transatlantic television submarine cable could be developed if there were sufficient demand.

They believe that such a development would take much less time than the 35 years taken by scientists to make it possible to lay the world's first submarine telephone cable.

Questions about the possibility of

POPULAR SCIENCE QUIZ

Q.: How fast do radio waves travel?

A.: When we were at school, we were taught that the speed of radio waves was 300,000 Km/sec or roughly 186,000 miles/sec.

This was accurate enough for most purposes ad a very convenient figure for calculations.

However, the instruments used for determining this figure were far from accurate, at least as far as the scientists were concerned. During and after the last war instruments of much higher accuracy became available and many scientists, among them Essen, Bergstrand, Aslakson and Froome, renewed their efforts to obtain more accurate results.

At the eleventh General Assembly of the International Scientific Radio Union the results were compared and it was found that they closely agreed. The assembly therefore decided to recommend that the mean of these results, 299,792 Km/sec, with an accuracy of plus or minus 2 Km/sec, be accepted as the speed of electromagnetic waves in vacuum.

Subsequent investigations carried out have since confirmed this figure.

Under everyday conditions this speed may vary, due to differences in the dielectric constant of the atmosphere, but it is a comparatively easy matter to apply correction for these figures.

Q.: What is an image converter?

A.: Fundamentally, an image converter is an electron tube, somewhat similar in action to a TV camera tube. It serves to convert invisible radiation such as x-rays or infra-red rays into visible light.

One end of an evacuated glass tube is coated with a material which emits electrons when excited by say infra-red rays. The other end is coated with a fluorescent layer. A ring anode is placed around this fluorescent screen.

If a positive voltage of the order of 10,000 volts is put on the anode, it will attract the electrons emitted by the radiation sensitive coating. These electrons move across the tube at a very high speed, and their high momentum can carry them right through the ring anode to the fluorescent screen, causing it to light up.

If a pattern of infra-red radiation falls on the photo-cathode (that is the correct name of the radiation sensitive layer), the same pattern will be reproduced on the screen in visible light.

As infra-red rays can penetrate fog and haze it is possible to focus them onto the photo-cathode of an image converter which will then reproduce them as a visible picture. Thus one can see through the thickest "pea-soup" fog. In fact, that is exactly what image converters were used for during the war.

Imperceptible to the naked eye, infra-red radiation is also present during the night. With an image converter it becomes possible to see in pitch darkness.

This wartime invention has now been put to a peaceful use in hospitals. With an x-ray sensitive photocathode, clear and bright images can be seen with much less radiation intensity than was possible before with the ordinary fluorescent screen.

This benefits both the doctor and the patient, because there is a limit to the amount of radiation the human body can stand without harmful effects.

By arranging several anodes in the tube, the picture can even be enlarged or reduced at will after the fashion of the electron microscope.

New Release

PUBLIC ADDRESS AMPLIFIERS

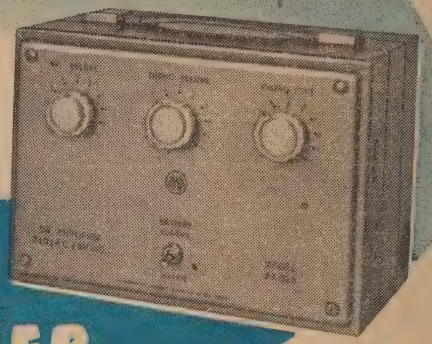
DUAL OPERATION mains or battery

The addition of two versatile mains and battery operated amplifiers to the extensive range of A.W.A. sound equipment provides for every requirement of mobile Public Address Operators.

Type PA828 amplifier may be operated from 240 volt or 6 volt battery supply, changeover being effected by alternate cables which are stowed in rear of housing. A standby switch is provided to conserve battery life.

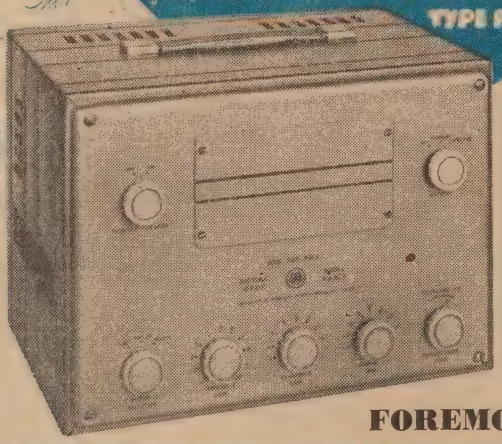
5 WATT AMPLIFIER

TYPE PA 828



20 WATT AMPLIFIER

TYPE PA 829



Type PA829 20 watt mains or 12 volt battery amplifier provides all facilities necessary for P.A. Hiring.

These include two microphone channels with third optional channel for microphone or pickup. Either high or low output pickups can be used. Features include a battery saving switch and a bass cut switch to control L.F. response when using horn speakers. A plug in V.U. meter and monitor speaker with their associated switches are ancillary units.

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ALSO FROM LEADING WHOLESALERS

transatlantic television were prompted by remarks made by Karn Honaman, an official of the Bell laboratories, in a radio talk about the new transatlantic telephone cable, laying of which is to begin soon.

Mr. Honaman said the "key" to the success of the project would be 104 electronic repeaters spaced at 40-mile intervals across the ocean floor.

These would boost power along the 2000-mile cable and make possible reception as clear as an ordinary intercity telephone call.

New "clock"

A NEW atomic clock could measure time more accurately than any device now known, say Columbia University physicists.

It could usher in "atomic standard time" rather than sun standard time, it was stated.

It was a far better timepiece than the earth's rotation, the basis of sun time or present standard time.

The earth's rotation could vary about one second every 300 years, said Professor Charles Townes.

One use foreseen for it was to measure how much the spinning earth might be slowing down, and how much it varied in the time —24 hours—needed for one complete rotation.

Vertical take-off

THE Bell Aircraft Corporation has developed a jet plane which will take off vertically from normal flying position.

Two Fairchild J44 turbo-jet engines, mounted on the fuselage just under the wing, power the plane.

At take-off, the pilot swivelled the engines so the jets were directed vertically at the ground.

Once airborne, the pilot rotated the engines 90 degrees to permit forward movement.

The plane, named the VTOL (vertical take-off and landing), differs from other vertical take-off planes because:

- It is powered by jet engines.
- It lands and takes off from a normal flying position, rather than from a "tail sitting" position.

Aircraft seating

ALL new civil airliners imported into Australia after January 1 next year must have rear-facing seats, according to the Director-General of Civil Aviation (Air-Marshal Sir Richard Williams).

He said the requirement was laid down in the latest air navigation order issued by the Civil Aviation Department.

Sir Richard said RAF experts had established that passenger protection was three times greater with rear-facing seats.

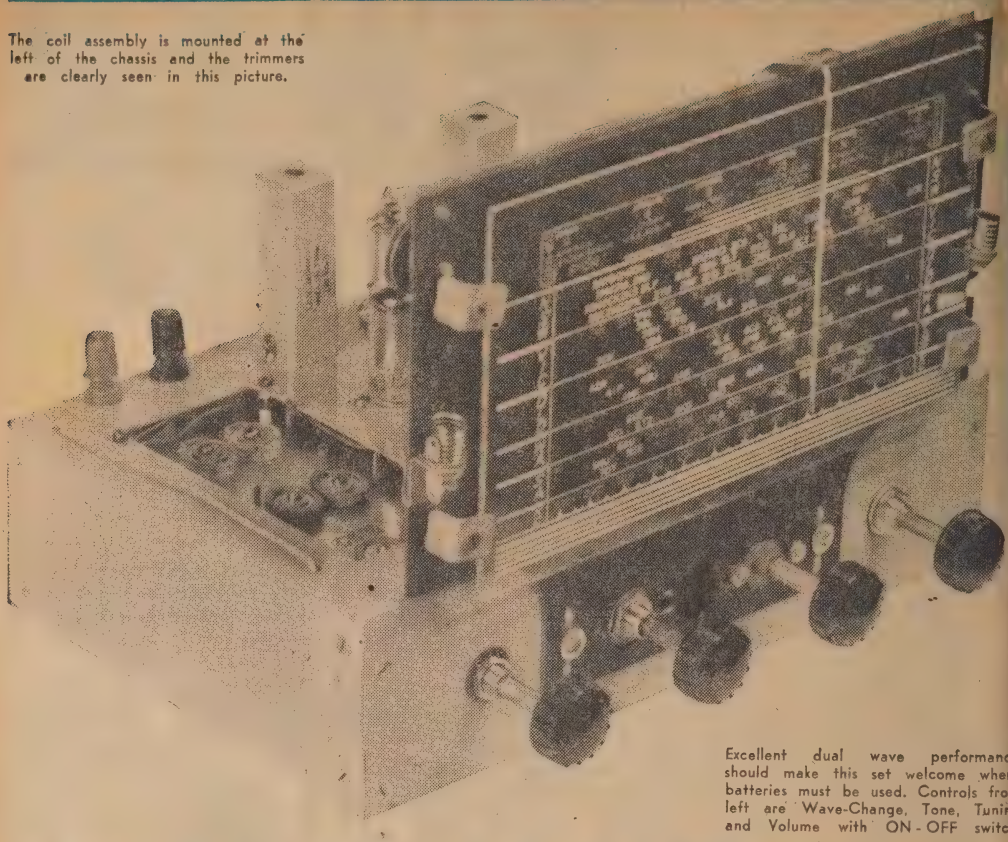
The new order also requires that seats face the rear if any major seating modifications are made to public airliners after January 1 next.

"Ultimately the present form of forward-facing seats will disappear from Australian airliners," Sir Richard said.

A recent RAF poll of passengers using rear-facing seats revealed that:

- 99 pc thought the view was better.
- One in three felt less airsick; and
- Bumps and noises were less noticeable.

The coil assembly is mounted at the left of the chassis and the trimmers are clearly seen in this picture.



Excellent dual wave performance should make this set welcome where batteries must be used. Controls from left are Wave-Change, Tone, Tuning and Volume with ON-OFF switch.

NEW DUAL-WAVE BATTERY SET

We have in recent months received a considerable number of letters about our apparent neglect of country radio enthusiasts who have no mains supply and who have to rely on batteries to run their receivers. Here, then, is a five valve D/W set to bridge the gap, a set offering excellent performance yet permitting economical operation on dry batteries.

by L. Varady

IN presenting such a set, there is little opportunity to spring any technical surprises, because the valve types on offer at the moment are the same 7-pin miniatures which have been available for years.

To be sure, certain lower-drain types have been mentioned in overseas literature, but there is no indication that they will be released, as yet, on the local market. There is more than a suggestion also that their added economy is achieved at the price of reliability and performance.

VALVE LINE-UP

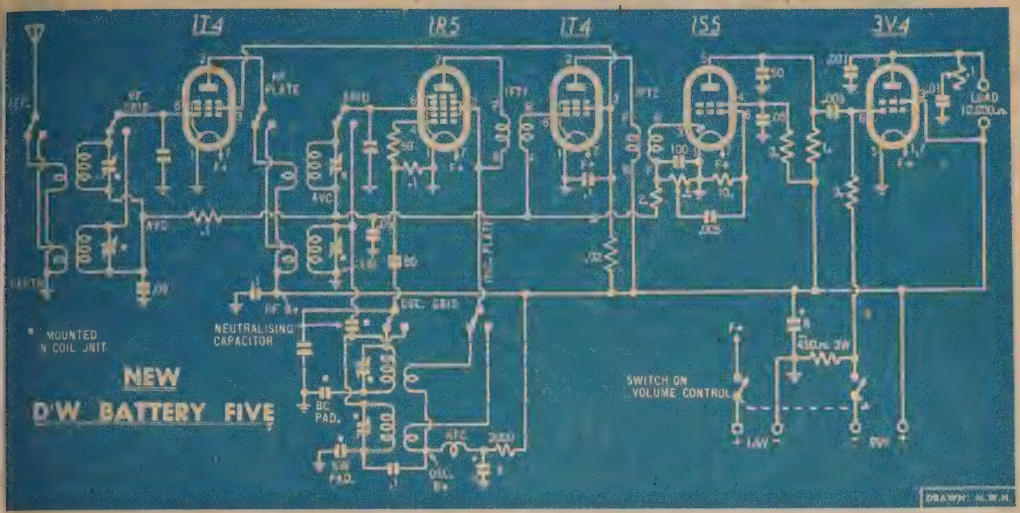
Be that as it may, however, the valve line-up contains a 1T4 RF amplifier, a 1R5 converter, a 1T4 IF amplifier, a 1S5 detector, AVC and AF amplifier and a 3V4 power output valve.

A commercially made coil bracket for dual-wave operation, high-gain IF transformers with a suitable dial and tuning gang and a handful of minor components, all assembled on a small chassis, make for an attractive little set, which is capable of a very good performance. To use a much abused phrase: It speaks for itself!

The reasons for including a short-wave section are fairly obvious. It is not always possible to receive broadcast stations in remote country 'areas' due to atmospheric conditions, but there is generally plenty of entertainment to be had from the shortwave bands. As a matter of fact, many city programs are transmitted on the short-wave bands especially for this purpose.

An essential feature of any receiver for country listeners is an RF stage. In our set, a 1T4 performs this function in a conventional circuit arrangement. AVC voltage from the diode is applied to the

CIRCUIT DIAGRAM OF NEW BATTERY D/W SET



The cricuit is simple and straightforward, but careful consideration of the operating conditions result in a receiver of excellent performance and good battery economy.

lower end of the coils on both short wave and broadcast through a .1 meg resistor bypassed by a .05 mfd capacitor.

UNIT IS WIRED

Although the coils appear separately in the circuit diagram, they are already wired, with the appropriate switching, in the coil unit. The constructor only needs to complete the external connections to aerial, gang, grid and AVC.

The same is true, in general, of the RF and oscillator sections.

As with any battery set, the oscillator requires special attention to ensure reliable operation at the low frequency end of the short-wave band.

Padder feedback was incorporated in the circuit for this reason. In this arrangement the .1 mfd bypass capacitor from the B-plus end of the oscillator feedback winding is returned to earth through the S/W oscillator padder capacitor. This helps to maintain oscillation toward the lower end of the S/W band.

To prevent audio frequencies from reaching the converter it is desirable to decouple the HT line by means of an 8mfd electrolytic. This would upset the operation of the padder feedback unless an RF choke separates the two capacitors.

Although the recommended value of oscillator grid coupling capacitor is 100 pF, this value tends to produce squegging on the S/W bands. To prevent this effect, we used a 50 pF capacitor and also included a 50 ohm grid stopper resistor as an additional safeguard.

AVC CONNECTION

AVC is applied to the converter only in the B/C band, the lower end of the S/W coil being returned directly to earth.

The precise effect of bias in this stage seems to vary with individual valves and in some cases it may be an advantage to apply a standing bias to the converter grid on S/W operation. The manufacturers of the coil unit actually recommend minus 3.0 volts and, for this purpose, the end of the coil is brought out to a tag on the side of the unit.

You may care to experiment to obtain best results in this respect. The necessary standing bias may be obtained by connecting two resistors of say .1 meg. across the back bias resistor, bypassing their junction with a .05 mfd capacitor and returning the lower end of the S/W RF coil to this point.

The IF stage, employing a 1T4 and high-gain transformers, operates under standard conditions. Control grid return is to the AVC line.

It may be of interest to mention here that the screen dropping resistor and bypass capacitor are common to RF and IF valves.

The pentode section of the 1S5 serves as an AF amplifier, whilst the diode doubles for the second detector and AVC source. AVC voltage is taken from the "hot" end of the .5 meg. volume control through a 2. meg. resistor.

In order to cut down the HT current the 3V4 output valve is deliberately overbiased, the bias voltage being developed across the 450 ohm back-bias resistor. Sufficient volume with tolerable distortion is available to fill an average living-room under these conditions.

BIAS VALUE

Should more volume be required for some reason, this resistor could be dropped to about 300 ohms, thus reducing the bias on the grid of

PARTS LIST

1 Chassis 11¼" x 8½" x 2¾"
1 Miniature dual-wave coil bracket with RF stage and suitable for 1R5 (type 1R5 DWR6 16/5C or similar).
1 3-section tuning gang capacitor (miniature AWA)
1 Dial with glass to suit gang (USL32)
2 IF Transformers 455 kc, Nos. 1 and 2, miniature.
5 Miniature 7-pin valve sockets, 1 miniature 4-pin plug and socket.
2 45-volt heavy-duty B batteries
1 1.5 volt heavy-duty A battery
1 RF choke.

VALVES

2 1T4, 1 1R5, 1 1S5, 1 3V4.

CAPACITORS

2 8mfd 350v electrolytics, 3 .1 mfd 200VW tubulars, 3 05 mfd 200VW, 1 .01 mfd tubular, 2 .005 mfd tub., 1 .001 mfd tubular, 1 100pf mica, 2 50 pf mica

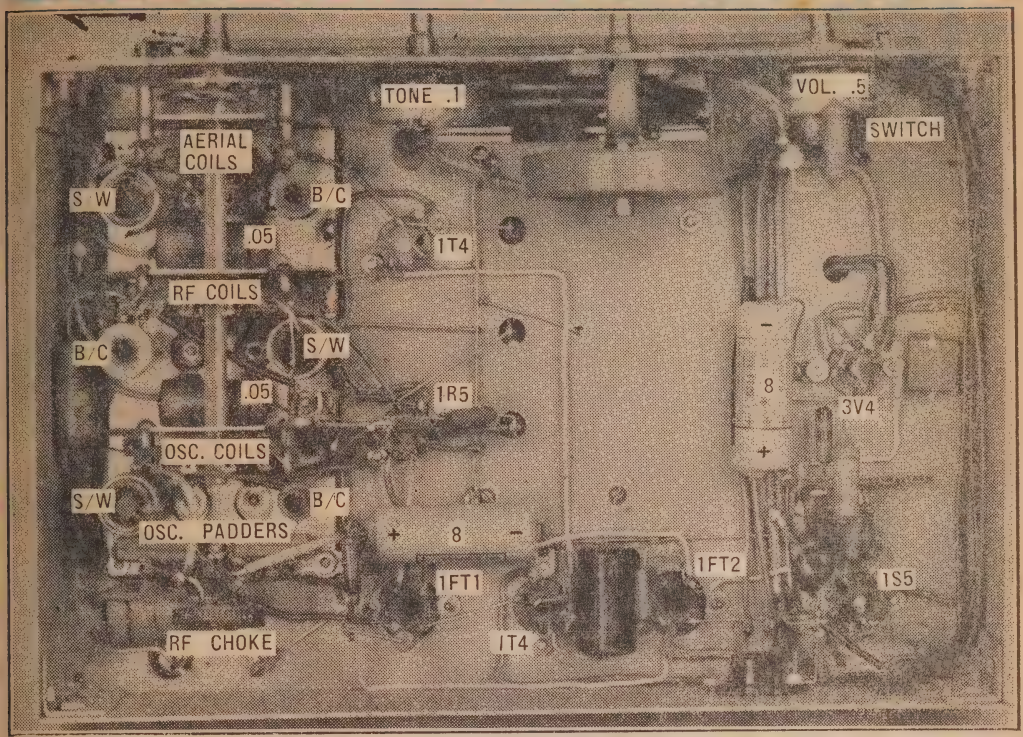
RESISTORS

1 10 meg, 2 3 meg, 1 2 meg, 1 1 meg, 1 .5 meg potentiometer (with DPST switch), 1 .1 meg potentiometer, 1 .1 meg. 1 .05 meg. 1 .02 meg, 1 15 ohm (all foregoing resistors ½ watt), 1 450 ohm 3 watt wirewound, 1 2000 ohm. ½ W.

SUNDRIES

2 Terminals (1 red, 1 black), 3 knobs, 2 2-tag, 2 3-tag and 1 5-tag mounting strips. ½yd shielded hook-up wire, solder, solder lugs, hook-up wire, tinned copper wire, nuts and bolts, &c.

UNDERCHASSIS VIEW SHOWS COMPONENT POSITION



There is plenty of room for all components under the chassis. Care should be taken with the wiring not to obstruct the tuning slugs of the IF transformers. The lead across the centre of the chassis is the screen supply for the RF valve.

the output valve. This would, however, increase the drain on the B-batteries. If the bias for the converter valve is also taken from this resistor, it may be necessary to alter the values in the voltage divider circuit supplying that valve.

As the circuit stands, total HT drain with "no signal" is approx. 14½ ma, which drops to about 12 or 13 ma on signal. The LT drain remains constant at about 300 ma.

Having discussed the most important points in the circuit, we now turn our attention toward constructional details.

CHASSIS SIZE

The set is built on a chassis measuring 10½ x 6¾ x 2½in. Although the photograph shows all miniature components, we have deliberately left enough room for standard size components, should they be on hand.

A cutout on the front of the chassis allows the dial to be fitted without dismantling, whilst a large rectangular cutout along the right hand side provides access to the slugs and trimmers on the coil unit.

The tuning gang occupies the centre portion and the valves are grouped around it in their logical sequence. The IF transformers each occupy a position at the back and to the sides of the gang.

Aerial and earth terminals were placed along the rear edge of the chassis, behind the coil unit cutout. For certain reasons to be explained later, we have also placed the output transformer on the chassis on the left just behind the dial.

The first step in the construction would be to mount all the valve sockets and major components into place, except the coil bracket, taking care that all sockets and connecting pins are suitably orientated.

SOCKET ORIENTATION

Taking the gap between pins 1 and 7 as a reference point we have the RF and converter sockets pointing toward the centre of the chassis, likewise the IF and power output sockets. The socket for the AF amplifier points toward the rear left-hand corner. Both IF transformers have their "F" and "G" pins parallel to the rear edge.

To avoid instability due to bad earthing, we have found it advisable to bring all earth connections together on a busbar, bonding this to chassis in several places. Accordingly we placed soldering lugs under two mounting screws of the tuning gang, and one each under the inside mounting screws of the 3V4, 1S5 and 1T4 sockets, connecting them with a piece of tinned copper wire.

Next the filament wiring was put into place. On the first four sockets (for the 1T4, 1R5, 1T4 and 1S5) pin 1 was connected to the centre spigot and to the earthing busbar. The filament centre tap of the 3V4, pin 5, was also earthed. Pin 7 on the first four valves and pins 1 and 7 of the 3V4 were interconnected with insulated wire. This formed the positive side of the filament circuit.

Some means of switching the filament circuit had to be incorporated. For his purpose we used one section of the double pole switch on the volume control, connecting the positive terminal of the filament battery through this to the positive side of the filaments. No switching was used for the negative side, the negative battery terminal being earthed to the chassis. At the same time the second section of the switch was used to interrupt the HT supply to the set.

SWITCHING

A word of warning, however. Before attempting to make any connections to the switch, make sure not to mix up the terminals. There seems to be no uniform pattern for these switches, the connections varying from one make to another.

A torch bulb and the filament battery are all that is necessary for this test. Connect these and two terminals of the switch in series and switch on. If the bulb lights up it indicates that these terminals belong to one section, the other two obviously belonging to the second section.

The coil unit for which the cir-

cuit and chassis layout have been designed was a Q-plus midget D/W bracket, which is the only one currently available, for battery valves. Kits intended for use with AC valves could not be expected to perform reliably, particularly on the short waves.

A wiring diagram on the carton shows the position of connecting leads and terminals.

There are certain additions to be made to the coil bracket, and it may be wise to carry these out before fitting it to the chassis.

Viewing the unit from the bottom two terminal strips can be seen on the left hand side. One is an AVC connection, whilst the other carries another AVC and a B-plus terminal.

A.V.C. COMPONENTS

From each of the AVC terminals a .05 mfd capacitor should be connected to the frame of the unit. The .1 meg decoupling resistor is then suspended between the terminals.

Wire a 0.1 mfd capacitor from the B-plus terminal to frame. A flying lead, about 8in long, should also be soldered to this terminal, connecting to the rest of the circuit when the unit is placed into position.

Another lead should be attached to the AVC terminal nearest to the B-plus terminal for the same purpose.

As mentioned in the circuit discussion, the lower end of the S/W coil should be earthed directly. Actually, this coil is connected to a tag strip on the right hand side of the unit. A short piece of tinned copper wire soldered between the lug on the strip and frame completes the circuit to earth. For converter operation with negative bias, this lug should be connected to the voltage divider across the back-bias resistor.

At the rear of the bracket there is a terminal strip supporting the oscillator padders and coil leads. The RF choke necessary for the padder fedback can be soldered to the terminal marked "Oscillator B plus" and the unused lug on this strip.

The .1 mfd feedback capacitor could then be connected between the oscillator B-plus terminal and the oscillator padder.

ADDITIONAL TAG STRIP

Oscillator plate dropping resistor and HT decoupling capacitor can be supported on a four lug terminal strip held under the rear inside fixing screw of the bracket.

The 2 meg resistor in the AVC line, mounted vertically above the "F" pin of the 2nd IF transformer also connects to this strip.

A further tag strip was soldered to the shield directly above the converter socket supporting the oscillator grid resistors and capacitor.

The pigtails from the bracket are just long enough to reach the respective valve sockets as indicated on the carton. Having carried out these modifications we fitted the unit to the chassis.

Simple point to point wiring was used in the IF stage.

Nearly all components for the audio section were mounted on a tag strip halfway between the 3V4 and 1S5 sockets.

The battery leads were terminated on another tagstrip directly above the 1S5 socket. This also carries the back-bias resistor. Leads were taken from here to the remaining pair of contacts on the volume control switch to interrupt the HT supply when the set is not in use.

The volume and tone controls were connected into the circuit by means of shielded leads.

Some care should be taken when connecting the tone control lead to the plate pin of the 3V4, because the shielding may easily short circuit the HT to earth, stopping the set and placing undue drain on the batteries.

It is also advisable to slip a short piece of spaghetti over the volume control lead where it passes the socket of the 1S5. Any chance of the shielding causing a short circuit is thereby eliminated.

Bonding the leads together and to earth helps to keep them in their place and also prevents hum pickup.

TRANSFORMER PLACING

With the output transformer mounted on the speaker it would have been necessary to take the plate lead of the 3V4 right across the chassis to the output socket, inviting instability. Also, if the speaker plug were accidentally removed, the whole of the load would be placed on the screen of the output valve, with perhaps disastrous results. The output transformer was therefore mounted on the chassis, with the secondary connected to the speaker socket.

As a safety measure for the glass, the dial was mounted into place as the last item.

The battery leads should be differently colored or conspicuously marked to avoid disaster with the valves. As an additional safeguard it is advisable to check with a 1.5V torch lamp and a pair of leads if the correct voltage is applied to the filament pins, before plugging in the valves.

TORCH LAMPS CHEAPER

Both batteries should be connected to the set during this test. Of course, one could plug the valves in straight away and switch on. However, in our experience, torch lamps are far cheaper to replace than valves if something does happen to be wrong with the wiring.

After connecting the speaker and the batteries and plugging in the valves there should be some signs of life from the loudspeaker. Don't forget to switch the set on!

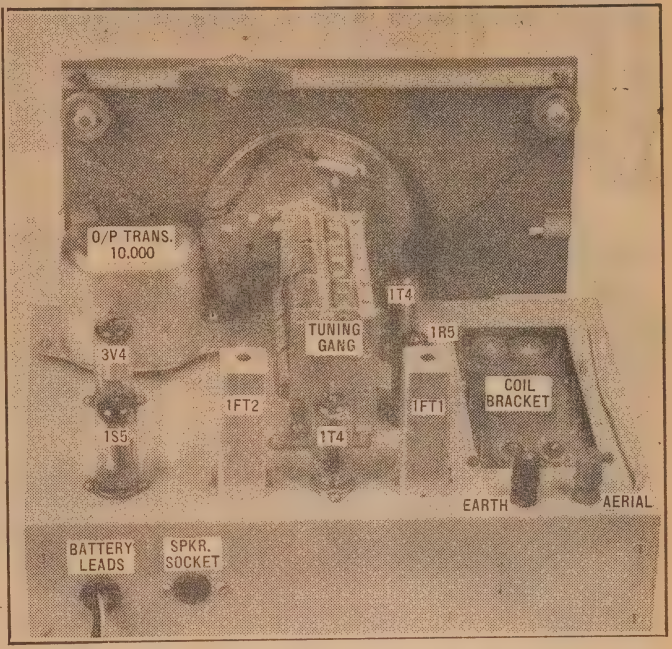
We need not say that best results from this set can only be expected if it is correctly aligned. Only then can the benefits of the RF stage and the high-gain IF stage be realised.

If adequate precautions are taken when installing the IF transformers and the coil unit, very little alignment should be required because they are set near their optimum point before leaving the factory.

If you are lucky enough to possess a signal generator all is plain sailing.

A modulated signal is fed into the tuned circuits at certain points, the

A REAR VIEW OF RECEIVER



A rear view of the chassis showing the layout and major components. Note that the aerial connection to the coil bracket is run above the chassis.

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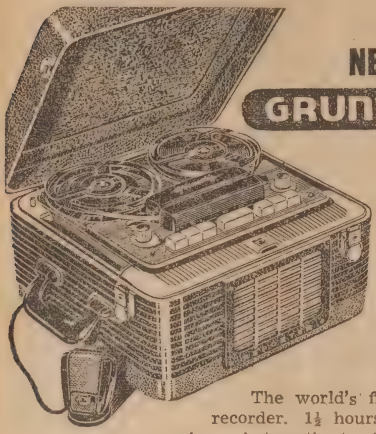

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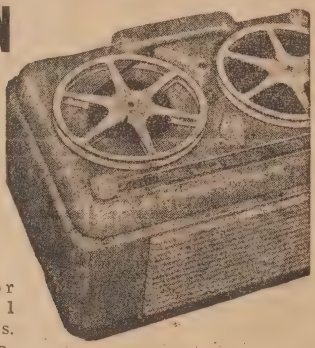

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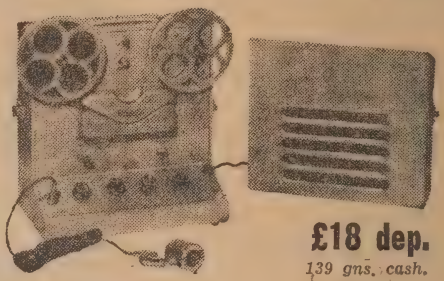

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ignal strength being read from an
AC voltmeter connected across the
oice coil or across the primary of
he speaker transformer.

First connect the signal generator
o the converter grid and set it to
55 Kc. Then peak the response of
he IF transformers at this fre-
uency.

If a particular core can be peaked
n two positions—right in and right
ut—it is a good rule of thumb
lways to choose the outer peak.

If there is a dial calibration point
rovided, the pointer can be set to
hat point with the gang fully closed.
Otherwise the pointer is best adjust-
d for equal overlap on both ends
f the scale.

Then connect the signal generator
o the aerial terminal and switching
o broadcast, adjust the oscillator
ore until 2FC (610 Kc) comes in
ine with the dial marking. Peak the
aerial and RF cores at the same
ime.

TRIMMER ADJUSTMENT

Tuning over to 1270 Kc (2SM) adjust the oscillator trimmer for correct tracking and touch up the aerial and RF trimmers for maximum response at this point. As this may have affected the setting on the low frequency end it would be wise to repeat the whole operation a couple of times.

The dial markings will not permit a very accurate alignment on the shortwave bands. The calibration points would be at 7.5 Mc (40m band) and 15.3 Mc (19m band). After adjusting the oscillator slug and trimmer respectively at these points, the aerial and RF slugs and trimmers can be used to obtain the highest sensitivity in the same place.

Quite good alignment can, however, be achieved without instruments, using one's ear for judging signal strength and the actual stations for a signal source.

As most home constructors will have to rely on this latter method we describe it also.

It may be noted that it is best to use some of the weaker stations for alignment as otherwise the AVC action may mask the effect of the adjustments.

ALIGNING BY EAR

Identify two broadcasting stations, one near 600 Kc and the other near 1400 Kc. Bring the lower frequency station to its correct position by adjusting the oscillator core and then set the aerial and RF cores on this same station for maximum response.

This done, tune in the higher frequency station and bring it to position by adjusting the oscillator trimmer. Then peak the aerial and RF trimmers for maximum output.

Repeat the whole procedure to correct any change that one adjustment may have made on the other.

Finally bring the gain up as far as you can by tuning the IF transformers to a peak. No more than one turn of the cores should be necessary to achieve this unless for some reason the cores have been moved from their original settings.

The same procedure applies for the short-wave band although the adjustment of the oscillator circuit is best left until some of the stations have been positively identified. No adjustment of the IF transformers will be necessary, as these have been aligned with the broadcast coils.

FINER POWDERS FOR TV SCREENS

SUPERFINE powders, composed of uniform particles so small that more than a thousand could line up single file across the head of an ordinary pin, are being separated with a moving air stream, using a device developed by the General Electric Research Laboratory.

One application of such powders, more than ten times as small as any which can be sifted through standard sieves, could be to increase detail and brilliance of pictures shown in television receivers.

The finest sieve commercially available has about 325 wires to the inch and will pass all particles smaller than about a two-thousandths of an inch in diameter. Finer sieves are very fragile and difficult to use.

With the "air sieve" there is no wire screen. The original powder, of particles of assorted sizes, is blown upwards through a vertical seven-foot glass tube, four inches in diameter. All the powder is lifted, but the smallest grains rise highest and are blown into a container at the top.

In using the device, technically termed an "elutriator", the original mixed powder is placed in a flask at the bottom and shaken mechanically. Then the air is gradually turned on, the speed being adjusted with the aid of a flow meter.

At first, only the finest particles, which may be less than a ten thousandth of an inch in diameter, reach the top. Here they pass through a tube that bends over to the side, and into a small collecting vessel. After this is removed and replaced with another such vessel, the air velocity is increased.

Then larger grains, perhaps from one to two ten-thousandths of an inch in diameter, are collected. Repeating this process several times, with still higher air speeds, the original unclassified powder may be sorted out into uniform samples.

A possible application of these ultrafine powders is in television picture tubes. If the luminescent coating inside the face, on which the picture appears, is very thin, greater brilliance may be obtained. The finer and more uniform the powders from which the coating is prepared, the thinner the coating may be.

Raisin seeds, which are usually discarded when the fruit is packed, contain an oil rich in vitamin F, the "skin vitamin", which is now being used in the making of cosmetics.

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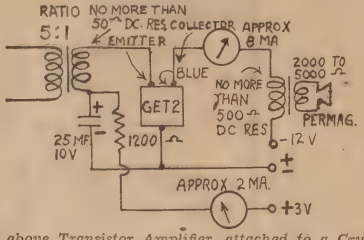
A PRACTICAL TRANSISTOR CIRCUIT



The above Transistor Amplifier, attached to a Crystal Set, has about 75 milliwatts' output—will operate an 8in Permag Speaker. Meters not essential—should be used to check for excessive current. Wrong polarity of batteries can spoil this P-N-P point contact transistor. So "caveat emptor." Note, collector, electrode colored blue.

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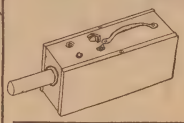

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EVERYTHING FOR THE RADIO AND ELECTRICAL EXPERIMENTER

FROM THE SERVICEMAN WHO TELLS

This month I have a few comments on old sets and when they should be scrapped, culminating in a description of a truly "vintage" type. By comparison there is a case involving battery problems in a personal portable, plus the trouble caused by some inexperienced fiddling.

WHEN is a set too old? At what point in its life should the owner be advised that it is better to cut his losses and buy a new set rather than try to patch the old one? This is a question which most servicemen are called on to answer quite frequently.

The cynic will, doubtless, reply that this depends entirely on whether you are a dealer trying to sell a reluctant customer a new set, or the reluctant customer trying desperately to keep his money in his pocket.

NATURAL TENDENCY

Perhaps that is a gross libel on dealers as a race, but it is undoubtedly true that any salesman will naturally extoll the virtues of the latest model and draw attention to the defects of the older ones—and often to good purpose as far as a sale is concerned. Whether the owner really need have bought another set is frequently a debatable point and involves the owner's own outlook as much as anything.

Accustomed as most of us are to thinking primarily in terms of the inside of the set; its circuit, its sensitivity, number and types of valves, &c., with the cabinet as a secondary consideration, it is often very hard to see things from the non-technical customer's point of view.

While the serviceman knows that, technically, this season's model is very much the same as last season's —and the season's before that—to the customer the new model is different because it looks different.

It has a new cabinet, a dial that is either longer or shorter, taller or rounder or, at any rate, has more of whatever is the current fashion. It has a new style in control knobs and a new placement of the controls, along with whatever other eye-catching gadgets the designer can think up.

APPEARANCE COUNTS

And to the customer these things are important; just as important, if not more so, than whether the IF valve has a gm of 2000 or 4000. This illogical and although this may seem, a new set is sold largely on appearance.

Of course, he is hardly likely to admit this, even to himself, so he allows himself to be "sold" a new set when repairs on his old one look like running into a few pounds.

A salesman, being able to sense such a situation (that's why he's a salesman) is quick to take advantage of it. Nor can we blame him. After all, if the owner has already half sold himself on a new set he will buy one somewhere and if the first salesman doesn't succeed, the second (or subsequent) one most certainly will.

But what of the customer who really cannot afford the luxury of "new look", but who genuinely believes that his existing set has "had it", and that he really needs a new one. How should he be advised when he asks you whether his old faithful is worth repairing?

I usually approach this problem by asking the owner why he thinks the old set is finished. What is it about the set that worries him? In what respect does it fail to do what he expects of it?

On the answers to these and similar questions one can usually give an honest and helpful opinion. If he complains of faults which can be repired, economically, then he can be advised accordingly, pointing out that it should be possible to put the set back into the same condition as when it was new, and giving some idea of the cost.

A NEW SET

If he wants features that do not exist on his present set, such as a shortwave band or a turntable and pickup, then he should be advised that a new set is the best proposition. In some cases it may be possible to add such features, but not often and such conversions are seldom satisfactory.

If the set uses valves which are no longer available, such as four-volt European types, for example, a defunct valve may create a difficult situation. What then? Should the serviceman attempt to substitute a more modern valve type for the faulty one, involving, as it does, all the problems of auxiliary transformers, &c., or should the set be converted entirely to more modern types, reasoning that the remaining valves will be close to extinction, anyway? Or, should the owner be advised to scrap the set and buy a new one?

Circumstances alter cases, of course, but in general I would be inclined to the latter course. Either of the other courses are likely to prove quite costly and thus hardly justified when the age of the remaining components is taken into account.

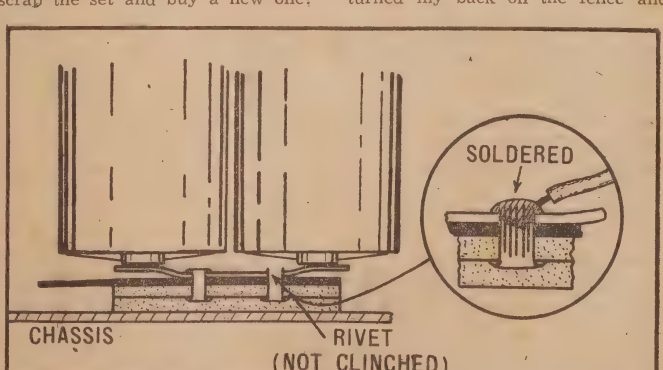
Proffering advice of this kind, when it has not been asked, calls for a lot of tact. Some owners become very "attached" to sets, believing that there has never been another like them before or since. They invariably maintain that they have never heard another set with a "tone" like it. In these circumstnces one can do little but stick to facts; the cost of conversion, the possibility of other parts failing, the cost and performance of a new set, and so on.

Naturally, all these words of wisdom were prompted by a particular case. It all started with a call for help—literally—from one of my next door neighbors, an elderly lady whom I knew to be alone in the house.

HOW IT HAPPENED

Thus, when I heard my name called with a note of desperate urgency, I visualised nothing less than robbery with violence. However, as I was about to jump the dividing fence (a feat strictly against my doctor's advice and my own better judgment) there came a second frantic call from which I managed to decipher the words ". . . smoke coming out of the wireless".

Calling out to switch the thing off I took another look at the fence and decided that a few more minutes wouldn't matter much at this stage. The damage, whatever it was, was done and once the power was turned off it was unlikely that I could do much except discover the cause. I turned my back on the fence and



First trouble in a personal portable receiver was a loose rivet on the A-plus contact. It produced a serious and erratic voltage drop.

ıde my way to the next door
ınge by the more conventional
rite.

By the time I arrived the worst
the smoke had cleared and the
ner had calmed down somewhat.
e set was a console model and had
ginally featured a gramophone
otor and pickup above the chassis,
e cabinet having the conventional
lt-up lid. The motor board had
ıg since departed (why I was
able to discover) so that lifting the
gave one a direct view of the
assis.

DUCED VOLUME

It seemed that the set had been
nning for some time when the
ner noticed that the volume had
opped. Without being quite sure
ıy, she lifted the lid to look in-
ie, only to be greeted by a cloud
smoke; thick, black, and evil
ıelling, as only transformer smoke
n be. Naturally this had been
cumulating for some minutes and
is little wonder that the sudden
sh called the dear old soul to
ınic. She really believed the entire
binet was alight.

Fairly obviously it was the old
ory. A broken down first filter
ndenser, a rectifier tough enough
"take it" for several minutes, and
power transformer which eventu-
ly gave up the struggle in a cloud
smoke.

But these facts were of secondary
ıportance. What really intrigued
e was the age of the set. If ever
ey run a competition for vintage
dio sets this should have a good
ıance of winning.

The first thing that caught my eye
as the tuning condenser. This was
three-gang type, made up from
ıree old "Pilot" brand single-section
ndensers. These were coupled to-
ether with mechanical couplers;
uite a common practice in the early
ays of "single dial control".

Almost as intriguing were the coil
ans. These must have been at least
ree inches in diameter, with an
lmost equal distance between them.
s a result they occupied more than
alf the length of a generous size
hassis.

RIGINAL VALVES?

Then there were the valve types.
here was one RF stage (the other
ıned circuit apparently operating
s a band-pass arrangement) and
ıis used a type 35 screen grid valve.
o be more correct it was a type 235,
eing a relic from the days when
ach manufacturer used a distinctive
refix number.

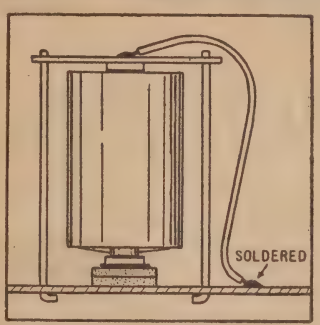
The detector was a type 224-A and
ıis appeared to be direct coupled to
245. All these were apparently the
riginal valves, the only modern one
eing the rectifier which was con-
emporary style 80. Presumably
ıe original had failed a couple of
ears ago. The power supply was a
alf-wave affair, as was customary
ith direct-coupled circuits, and the
lters were a pair of paper 4 mfd
ndensers.

After all this I would not have
een at all surprised to find the
peaker as being a balanced arma-
ire type or something of like vin-
ge. But no, they had at least man-
ged to use one of the "new" mov-
g coil types, doubtless regarded as
ıe last word in its day.

The owner placed the age of the
et at 20 years, bringing in several events of the family history to prove the point when I diffidently suggested that it might be a little older. I didn't press the point but I would say that such a set had seen several years operation by 1934.

After all, the old Wireless Weekly "Standard" was produced in 1933 and the superhetrodyne was well established by that time. We had electrolytic condensers, pentodes for most stages in the set, including the output stage, diode detection was coming into its own and AVC had already made its appearance, even though it had to wait a little for universal acceptance.

Also gang condensers were made in one piece, coil cans had shrunk



Further voltge drop was traced to the clip holding the batteries in position and providing the A-minus connection.

considerably in size, and some of the more progressive sets were even featuring tuning indicators; mechanical admittedly, but tuning indicators, nevertheless.

Looking at the set again I found it hard to reconcile it with this era. More like 1928 or 1929 as nearly as I could place the type, and that, in round figures, is 25 years ago.

In answer to the owner's query as to what could be done for the poor thing I shook my head. This was one case where I certainly had no doubts. The old set was just not worth repairing. Any set which has worked solidly for 25 years has lead a full and useful life and is far better given a decent burial.

NOT AN EASY JOB

Of course the set could have been repaired. But, as I pointed out to the owner, it would certinly require a new power transformer, not a cheap item in itself, plus a considerable amount of work to fit it, since it was obvious that a modern style would be quite different in shape from the one it was replacing.

All this would add up to quite a tidy sum, but it was not the end of the story. The set had originally been wired with plain rubber-covered hook-up wire. The rubber had long since hardened and perished and was now clinging to the wire in small, irregular beads. Once disturb that lot and nothing short of a complete rewiring job would be satisfactory. Even if assessed on the most neighborly basis, such a bill would be a worthwhile contribution to a new set.

Even the owner realised the hopelessness of the situation and accepted my advice philosophically. Nevertheless, she had to have the last word, "It's a pity, you know. It's always been a good set. It had such a lovely, clear tone."

By comparison, my next case brings us back to the present with a rush, involving a type of receiver undreamed of 25 years ago.

I was just closing things up, the other evening, when one of Her Majesty's sailors hove in sight, carrying a well-known brand of personal portable. He was on leave and wanted the set rather urgently.

"Seems to be intermittent," he explained. "You have to push at the batteries to make it work."

"Batteries okay?" I asked.

"Yes," he assured me. "They're new."

"What's this wire hanging out of the lid?" (about three feet of it).

"Oh, that's an extra bit of aerial that we had to fix up."

A GOOD IDEA

I mentally registered that a personal portable might need an outside aerial when sailing the high seas in a steel ship. It seemed like a sensible "extra".

However, since even radio servicemen have domestic and social obligations, including hot meals that get cold if you're late, I explained that I couldn't do the set on the spot but would look at it "first thing in the morning".

Next morning, I switched it on in the usual way by opening the lid, but was greeted by no more than a desultory plop. There were certainly no signals to be heard from it.

I duly opened up the back and tried pushing at the batteries as had been suggested. Apparently I didn't have the right kind of push, because my efforts produced only a series of scratches and plops.

Discarding brute force for science, I reached for the multimeter and, with the range switch set on 250 volts, prodded around one of the sockets. Having located what was obviously a filament pin, I then reset the meter to 10 volts and tried again.

The reading, this time, averaged about half a volt. I say "averaged", because pushing at the two torch cell A-batteries caused it to vary from almost nothing to nearly a volt. It was obviously a case of a bad battery connection.

Closer inspection showed that the positive tips of the two cells rested on a spring leaf, which was attached by two tubular rivets to a metal contact lug and a couple of thicknesses of supporting bakelite. One of the rivets was not clinched over properly, allowing the contact leaf to move out of position.

A WAY OUT

The movement had apparently loosened the second rivet, because it wasn't exactly tight.

Since the matelot was due to show up any moment, I didn't fancy the job of dismantling the whole box and dice. Perhaps there was an easier way? Yes, there was!

With the point of a small screwdriver I scraped and cleaned the inside of the faulty rivet, then packed it with scraps of tinned copper wire, just long enough to poke up through the contact leaf. Using the merest touch of flux and a hot iron, I then flowed solder down into the rivet and over the face of the contact.

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Prim: 5000, 3000 ohms. P.P.
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Prim: 5000, 3000 ohms. P.P.
Sec.: 500, 250, 166, 125, and 100 ohms.

TYPE 896 — 15 watts.
Prim: 10000, 8000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7, and 2 ohms.

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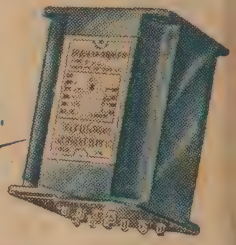

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LOOK FOR THE SILVER-GREY TRANSFORMER

When cool, it was as solid as the proverbial Bank of England.

Finally, as a precaution against further poor connections, a small bridge of wire was run from the new pool of solder to the contact lug carrying the filament lead.

A good job, well done, I thought.

The only trouble was that the set still didn't operate, and a check with the voltmeter showed that the filament voltage was still very unsteady, though higher than it had been. Since it couldn't be the A-plus connection, what about A-minus?

The negative connection to the cells was made by a metal platform carrying a further spring contact on its underside. The platform clipped over a couple of metal uprights coming through from the underside of the chassis.

It seemed like clean metal-to-metal contact all the way through, but looks were deceiving. A check with the meter showed a definite negative voltage between the case of the cell and chassis. Obviously, the metal plating had become sufficiently fouled to produce some resistance and voltage drop.

SOLDERED CONNECTION

To overcome this trouble, I simply soldered a short loop of wire from the contact platform to chassis. There would be no more troubles here.

This time, the filament voltage showed a steady 0.75 volt, with no sign of movement as I pushed the batteries around. But 0.75 volt? So much for the sailor and his "new" batteries!

When a couple of new cells were duly installed, the set played for the first time. But how it played!

The local stations were only just audible, and touching the metal work of the chassis or even holding a hand too close caused the signal to bubble in a most disconcerting fashion. I hope you know what I mean—that bubbling, humming, warbling effect that one sometimes gets from an open grid circuit.

Then I began to wonder about that aerial connection. How had they fitted it in? Had they connected it to the grid, to the AVC return, to a tapping on the loop, coupled it up via a small capacitor or added a tertiary winding? I'd better have a look.

ROUGH JOB

And what a sight met my gaze. The "we" who had done the job had unsweated the "earthy" end of the loop from the hinge which carried the connection into the set proper. The extra aerial had merely been soldered to the now loose end of the loop.

This completely ruined the effectiveness of the input tuned circuit and left the converter grid open circuited. Hence the poor performance and the bubbling noises.

What was equally serious, the movement of the external aerial wire, coupled with rather rough handling, had stripped several turns loose from both the inside and the outside of the loop.

They hadn't been able to solder the litz wire properly, either, and the strands which were not soldered had been wrapped around and stuck with what looked like "Tarzan's Grip".

Whatever other applications the said adhesive may have in a workaday world, I doubt whether the manufacturers ever envisaged its use as an electrical conductor.

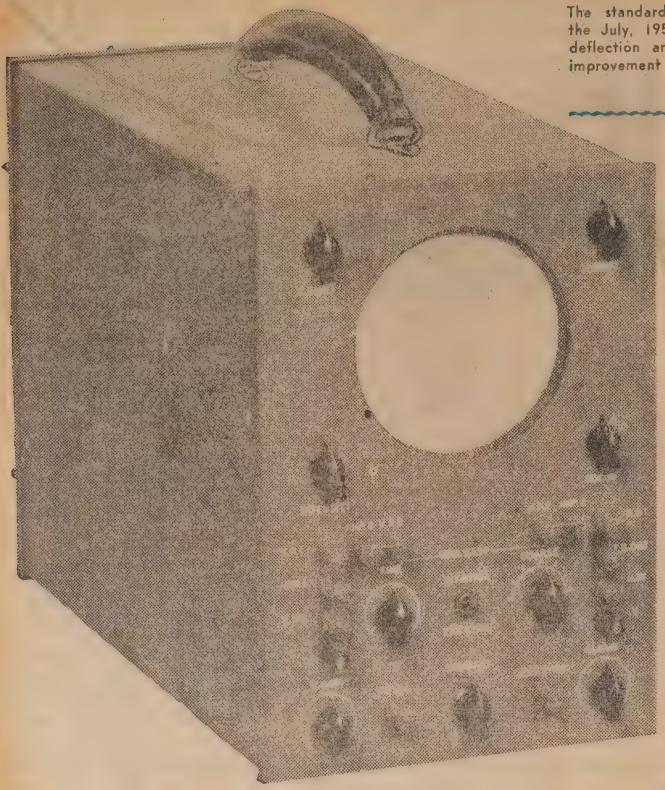
Needless to say, I set to work to restore the aerial circuit to its original form, reforming the loop as best I could, cleaning the ends of the litz wire with fine emery cloth and resoldering them to their respective hinge connections.

IT REALLY WORKED

This done, the set began to play like a beauty—an effect that was heightened still further by a spot of alignment.

A few minutes later, the young sailor sallied forth very happy and presumably in search of whatever wife he hopes to have in this particular port.

He wasn't sure that the set would need an extra aerial now, but he's going to let me know. He realises, I think, that there's more to connecting an extra aerial than unsoldering a likely-looking lead and attaching something to it with "Tarzan's Grip".



The standard 5-inch oscilloscope originally described in the July, 1952 issue. By modifying the present push-pull deflection amplifier and adding one extra valve, a big improvement can be achieved in the high frequency response.

WIDE RESPONSE FOR 5-INCH CRO

Readers who have constructed one or other of our 5-inch oscilloscopes should be interested in this article, which discusses ways and means of improving the response of the vertical amplifiers. An instrument, so modified, is better able to depict angular waveforms and ringing effects when testing high quality audio equipment.

by W. N. Williams

UP till a few years ago, the design of "audio type" oscilloscopes followed along more or less routine lines.

The signal to be inspected was fed to a couple of terminals on the panel and thence to a high-resistance gain control, usually a 1.0 megohm type.

From this input control, the signal was passed to one or more resistance-coupled amplifier stages, operating with circuit conditions similar to those found in an audio amplifier.

The amplified signal output was then applied to the active deflector plate, or to both deflector plates, where the design of the tube and instrument called for a push-pull deflection system.

The time base signal was applied to the opposite set of deflector plates, being derived in most instances from a gas-triode discharge circuit. In keeping with the normal role of the instrument, this circuit, too, had to operate effectively over the audible range.

Oscilloscopes designed along the conventional lines just described are convenient to use and adequate for the jobs they were primarily intended to do. These include such things as indicating approximate response and gain over the audio range, depicting nonlinearity and waveform distortion, tracing hum and so on.

The stage gain of the amplifiers can be quite high, allowing the instrument to be used readily for the inspection of low-level signals and hum voltages. Furthermore, the relatively high input impedance does not greatly disturb the circuits under test.

Conversely, adjustment of the input control allows very high orders of signal voltage to be inspected without danger of overloading the deflection amplifier. It is entirely possible to inspect the signal at the input of an audio system representing less than a volt and then transfer the test lead to an output plate, where the signal level may be a couple of hundred volts.

MORE EXACTING

While such versatility in use is as important nowadays as ever it was, the whole approach to amplifier testing has become more demanding. It is no longer sufficient to inspect waveform within the audible range and try to judge performance by noting any deformation of the pattern.

The performance of speakers, pickups (and records) has been improved to the point where much more rigorous testing of the amplifier is warranted.

Designers are striving to achieve extremely low figures of distortion and to eliminate various peculiar effects at frequencies outside the audible range, on the supposition that such distortion and effects can degrade the final result.

Frequency response is normally checked nowadays over a wide range with an accurately calibrated output meter or VTVM Distortion percentages, much too small to be apparent on the face of a CRO, are measured by means of a Distortion Factor Meter, Wave Analyser or Intermodulation Test equipment.

The job of the oscilloscope is to reveal any tendency to high frequency oscillation, either when the amplifier is quiescent or delivering output power. It should show the amplifier's ability to handle angular waveforms — square or triangular

— indicating any tendencies to "overshoot or ring."

It provides, in fact, important evidence of the amplifier's characteristics in the supersonic region, its stability, the behavior of the feedback network and so on. Very obviously, accurate portrayal of such phenomena on the screen is only possible if the oscilloscope has a smooth and sustained response over this portion of the spectrum.

Again, the shape of angular waveforms emerging from an amplifier is quite significant, indicating at a glance the low and high frequency performance and, of course, transient response.

MUST BE RELIABLE

With sine-wave input, the oscilloscope provides a ready check of output and overload characteristics toward and beyond the ends of the audible range. Such information might be required to evaluate, for example, the relative merits of certain output transformers.

It is obvious that such tests and observations can only be valid if the performance of the oscilloscope itself is above reproach.

It must therefore be free from obvious non-linear effects. This means that the deflection amplifiers must not approach overload with any usable size of pattern on the screen. It also means the use of push-pull deflection with tubes like the popular 5BP1.

It means, too, that the vertical amplifiers must have a smooth and wide frequency response and be free from ringing effects. Unless this is the case, the instrument will never be able to reproduce an angular waveform accurately, let alone depict any discrepancies therefrom.

It is in the matter of frequency response that the traditional "audio type" oscilloscope is most notably lacking.

While good response might have been available by direct connection to the deflection plates, the range of signal voltages which can be inspected in this way is very limited. In practice, most tests have to be made with the amplifiers in circuit.

Figure 1 shows the response of a typical oscilloscope, built along traditional lines. The variation in the height of trace has been converted, for ease of reference, to a decibel relationship.

TYPICAL CURVES

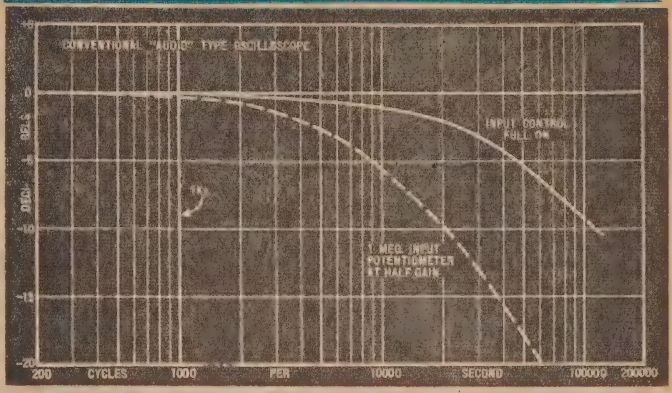
With the input control full on (solid curve), the response begins to taper off noticeably at between 10,000 and 20,000 cps, being 10 decibels down at 100,000 cps. This is serious but perhaps not tragic.

What is tragic is the abrupt drop in frequency response with the input control near mid position. (Dotted curve). The response is seen to be nearly 6db down at 10,000 cps and 20db at about 60,000 cps.

Thus, in the very region where ringing and oscillatory effects are most likely to be evident, and at a likely setting of the input control, the length of trace is reduced by a factor of at least 10:1.

Just how important this can be is illustrated in figure 2, which contains several patterns traced directly off an oscilloscope screen.

RESPONSE OF CONVENTIONAL C.R.O.



These curves show the response of a typical old-style oscilloscope. Note the gross frequency error which is introduced when the input control is turned back to approximate centre position—where it is so frequently used.

They show the output from an amplifier which we deliberately "rigged" so that it would oscillate, as amplifiers often do, over portion of the power output cycle.

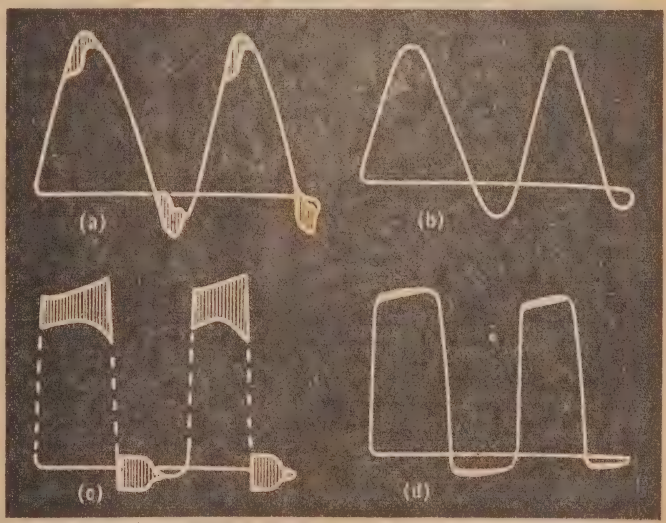
The oscilloscope was as described elsewhere in the article, but, for two of the patterns, the frequency response of the vertical amplifiers was artificially restricted to the dotted curve in figure 1.

Figure 2a shows the output from the amplifier, as it really was, with an oscillation "sac" on both peaks of a sine-wave signal. Figure 2b shows the same pattern under conditions of restricted CRO response. The oscillation is scarcely evident, being little more than a slight thickening of the trace. A casual observer might not even notice the effect or, at best, might put it down to a loss of focus at that point on the screen.

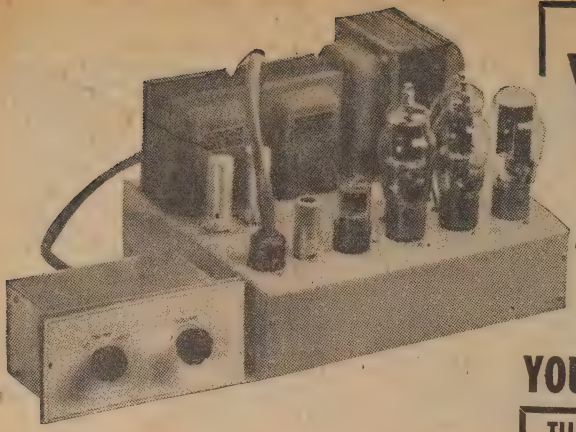
This is entirely consistent with a reduction in amplitude of more than 10:1 at the frequency concerned.

Figure 2c gives some idea of the pattern from the same amplifier when handling a square-wave input. The whole top and bottom of the wave is disrupted by high frequency oscillation. With restricted response, the oscillation is evident only as an unnatural thickening of the pattern at top and bottom.

An illustration like this amply explains the disruptive effect on amplifier performance of what appears to be, on an old-style oscilloscope, a very small sac of oscillation.



Surprising but entirely factual are these tracings of the output from an unstable audio amplifier. Figs. (a) and (c) are from a wide-range oscilloscope, figs. (b) and (d) from one with a response approximating the dotted curve above.



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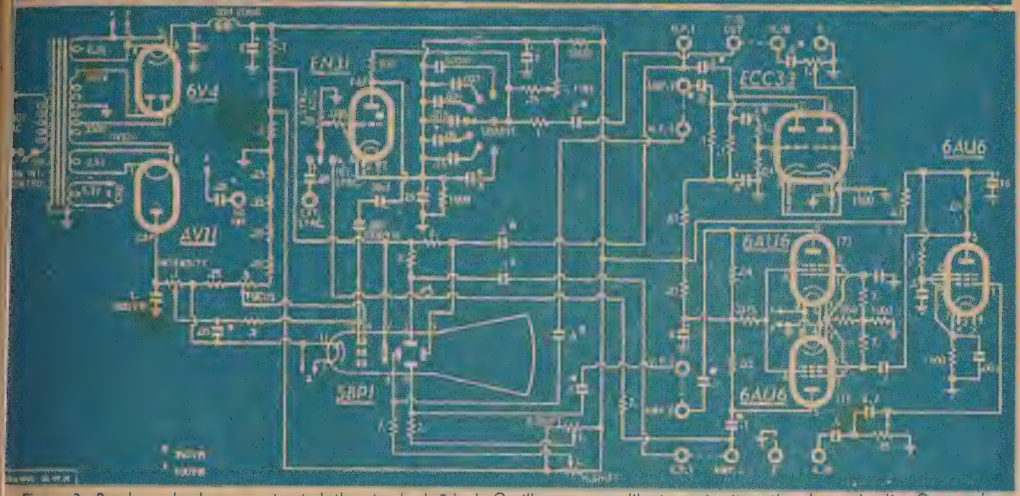


Figure 3: Readers who have constructed the standard 5-Inch Oscilloscope may like to rewire it to the above circuit. Curves elsewhere show the vertical amplifier response which can be expected.

The loss of response in a CRO at high frequencies is primarily due to the shunting effects of "stray" capacitance across the input and output circuits of the deflection amplifiers. It is made up by the input and output capacitance of the valves themselves, the capacitance across sockets and wiring and, last but not least, by that due to "Miller Effect".

While all these quantities can be minimised by careful wiring and design, there is a practical limit beyond which they cannot easily be reduced.

As the signal frequency rises from the audible into the supersonic region, the capacitive reactance of the various shunt paths gradually falls until it becomes comparable with the impedance of the interstage coupling circuits.

A diminishing load is thus presented to the amplifier stages, so that gain and peak output suffers. Less signal reaches the deflection plates and the vertical trace is reduced. The result is something like the solid curve in figure 1. Obviously, something needs to be done about it.

If, after reducing all stray capacitances to a minimum, the response is still not good enough, there is only one course left open. This course, normally adopted in video amplifiers, involves a drastic reduction in the values of plate load and therefore in the net impedance of the interstage coupling circuits.

LESS NOTICEABLE

Since the shunt capacitances remain substantially the same, their reactance can only become comparable with the reduced circuit impedances at extremely high signal frequencies. Television video amplifiers designed along these lines may have a response which is flat to several megacycles. In fact, they have to be designed that way to ensure good picture resolution!

The "catch" in the scheme is fairly obvious. A large reduction in plate load invariably involves a big drop in stage gain, so that gain is always something of a problem in a wide-range amplifier. The loss is countered partly by the use of valves having very high figures of transconductance, generally 10,000 micromhos or more.

You will probably have noticed such valves, from time to time, in the valve lists.

On the surface, the design of an extended range of reflection amplifier might therefore appear to be a simple matter. Take two or three of these new "video" valves, hook them up in an approved circuit, and have your CRO flat forthwith to several megacycles. It isn't as easy as that, however.

Video amplifier valves, operating in "approved" circuits, may draw nearly as much current as a receiver power tube. A complete, high-performance deflection amplifier will therefore require far more current than is normally available from a standard low-flux CRO transformer.

Nor is there any point in trying to conserve current by operating these special video tubes with extra bias or with low screen volts. In general, their transconductance decreases with the plate current to quite ordinary levels.

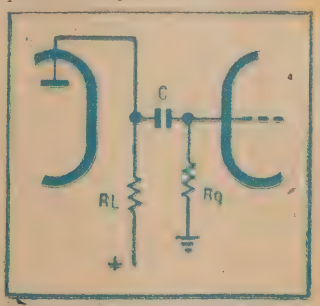


Figure 4. In general principles, high frequency response is extended by keeping RL low in value. Large values for Cc and Rg give extended bass response.

In short, as one examines the situation, it becomes clear that a response "megacycles wide" belongs to a much more elaborate class of instrument; to one having an ample power supply, able to handle audio, video and RF work alike, and provided with a time-base to suit.

Our immediate concern, however, was to "work over" a standard oscilloscope, give it a response wide enough for audio testing and avoid the abovementioned complications.

How we went about it is told in part by the circuit above. An examination of many curves showed that, for the few milliamps of current that would be available per stage, the 6AU6 would do just about as well as any other valve in terms of response, output and stage gain. Since these valves had been specified in the original oscilloscope, we had a second good reason to use them.

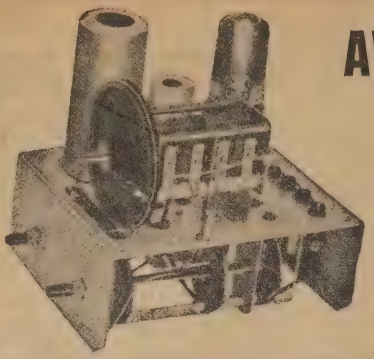
The 6AU6's have therefore been retained as the push-pull deflection amplifiers, but with considerably reduced values of plate load. These values are not as low as they could be from the viewpoint of frequency response, but it is necessary to bear in mind that the amplifiers have to deliver a high signal voltage to the deflector plates, without obvious distortion.

PUSH-PULL SYSTEM

Only the lower valve has grid drive, the upper valve receiving drive via its cathode circuit. An additional resistor in the cathode circuit, an unbypassed screen supply and deliberately unbalanced loads ensure a reasonable symmetry in the deflection voltages.

Individual adjustment of the plate loads will ensure exact symmetry, if desired.

In the original 5-Inch Oscilloscope, the test signal was fed to the driven grid via an input gain control. This was done because we were not unduly concerned at the time about volume control losses and because the single push-pull stage gave enough gain for our purpose.



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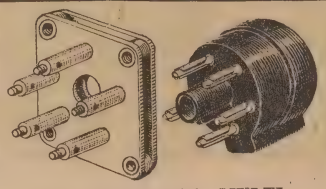

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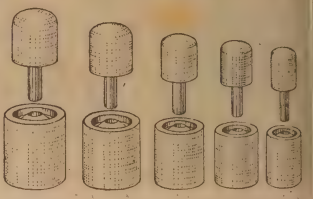

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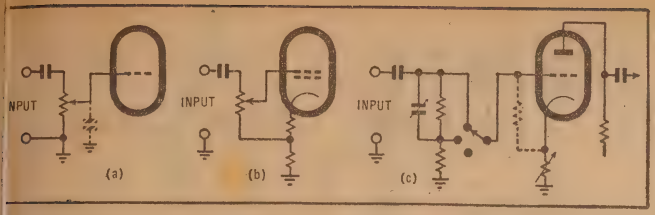


Figure 5: Illustrating the problems associated with amplifier gain control.

Such volume control losses have lready been shown to be prohibi- ve, where more advanced work is nticipated, while the gain has suf- ered by a reduction in plate loads, s just described.

Very obviously, an additional amp- fier stage was called for, both to nake up the lost gain and to solve, n some way or other, the gain con- rol problem.

It may be worthwhile to examine his gain control problem at some ength, because it will inevitably ecur in all future designs.

Diagram 5(a) shows a grid con- ected in the usual way to the mov- ng arm of a potentiometer, wired cross a pair of input terminals. rom the grid to earth is a symbol epresenting the total input capaci- ance to the stage.

As mentioned earlier, this includes he capacitance of the wiring and ocket, the natural input capacitance f the valve and "Miller Effect", qual approximately to the grid- late capacitance multiplied by the tage gain.

Miller Effect is, of course, very erious with triode valves, but, even assuming the use of a pentode, care- ful wiring and no shielded leads, he input capacitance cannot be re- duced to proportions which can be neglected. It is a very real factor n the operation of the circuit.

DIFFERENT SETTINGS

When the potentiometer is turned full on, so that the grid is connected directly to the input source, the net impedance to ground is often such that the valve's input capacitance s not significant. Similarly, with the potentiometer turned almost right off, the resistance from grid to ground is generally low enough to obviate difficulties.

It is near the centre position where the real problem occurs, for the im- pedance from grid to earth is then at a maximum and capacitive shunt- ing is most serious. How bad it can be is illustrated in the dotted curve of figure 1. The difference between it and the solid curve is entirely gain control loss.

The old scheme of bypassing the "hot" end of the pot. is of no real assistance, because the compensation which can be obtained by this method can be accurate at only one position. Elsewhere it is either too much or too little.

While over- or under-compensation is of no great consequence when viewing sine waves, it is most important with square-wave patterns. Under-compensation will round the corners of the wave, over-compensation will give it "over- shoot" peaks.

As a result, the shape of a square- wave, as viewed on the screen, varies with the pot. setting, so that the pattern becomes virtually meaning- less.

To be of any real use, an oscilloscope must not only be able to produce angular waves, but it must be able to do it accurately, irrespective of pot. setting.

In seeking a way out of this dif- ficulty, various schemes suggested themselves. The first is to reduce the value of the potentiometer so that capacitive shunting can have little effect in the desired frequency range. The objection is that the valve may have to be reduced to something like 0.1 meg, thereby limiting the usefulness of the CRO with high impedance circuits.

The effective input impedance can, of course, be increased by wiring a high value resistor between the in- put terminal and the potentiometer. In practice, any such resistor has to be bypassed with a small value capacitor to maintain proper division at high frequencies.

If a value is chosen for proper balance with the pot full on, it will be found that the network is over- compensated when the gain is re-

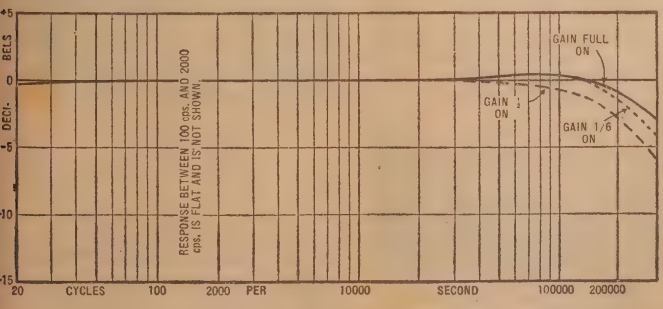
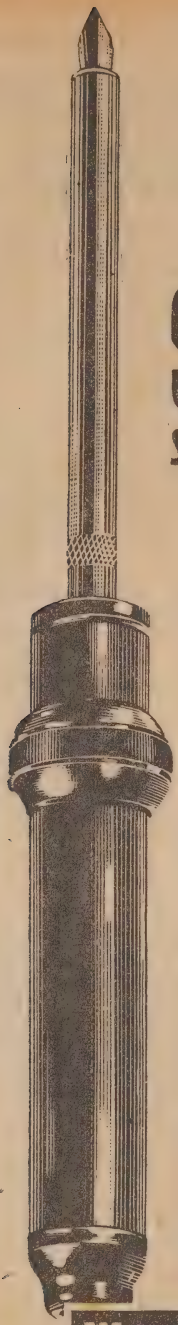


Figure 6: Measured response of the vertical amplifiers modified as per figure 3. Curves are for three separate settings of the gain control.



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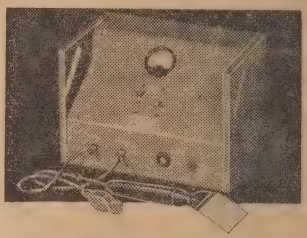

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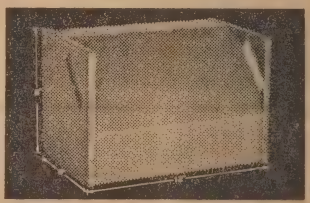

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duced. Angular waveforms are liable to distortion as a result, leading to the aforementioned doubts as to whether the amplifier under test is faulty or the oscilloscope.

Hum problems and the loss of effective gain entailed by an input divider system can also be serious.

Still another scheme is to use a low-value potentiometer, but to return its "earthy" end to the unbypassed cathode circuit of the first valve (Fig. 5b). As happens in the familiar phase splitter, this gives an artificial increase in the input impedance and allows capacitive shunting to be avoided at the same time.

However, a serious difficulty with the scheme is that portion of the input signal bleeds directly into the plate-cathode circuit of the first valve and thence into the next stage. With high-level input signals, this is enough to cause some deflection of the spot, even with the input control right off.

NOT SUITABLE

Advancing the control then produced a "minimum volume" effect, with incomplete cancellation and very confusing patterns on angular waveforms. It must therefore be reckoned unsuitable for general application.

By feeding the input signal directly to the grid of a cathode-follower stage, it is possible to use a low-value potentiometer between the cathode follower and the next grid circuit. This overcomes frequency errors very effectively, but it is also of little use in a general-purpose oscilloscope.

High-level input signals may easily overload the cathode follower, leading to grossly distorted patterns. In addition, the cathode follower generally represents an extra stage, because it contributes nothing to overall gain.

Figure 5c shows a practical scheme which is often used in better quality oscilloscopes. The signal input is routed first to a "coarse" gain control switch, which feeds it to the first grid through a number of fixed dividers, each one capacity compensated by a variable trimmer.

"Fine gain" is provided either by a low-value pot, later in the circuit or by a rheostat controlling the feedback and gain of the first stage (as in fig. 5c).

Apart from the complication of setting up an accurate divider system, the need for two controls is a nuisance in an already engraved and crowded panel. In the face of these difficulties, we approached the problem in yet another way, as indicated by the main circuit diagram.

First of all, another 6AU6 was added as a preliminary voltage amplifier, operating with a low value of plate load. This gives some useful extra gain but not enough to produce a too serious "Miller effect" problem.

LOW VALUE BYPASS

The cathode is bypassed by low value capacitor, intended to produce enough top lift to counter the natural losses in the two stages. If you have the facilities to do it, the value can be selected by trial and error, but the figure suggested will be very close to the mark.

The solid curve in figure 5 shows the natural response of the amplifier, thus compensated, from input grid to screen pattern.

"The GRAMOPHONE" reviews the VARIABLE-RELUCTANCE Turnover PICKUP No. 500

Goldring

Read what P. WILSON, M.A. reports about this outstanding production.

● *Mr. Wilson's technical reports in the English magazine "The Gramophone" are world-famous for their thoroughness and objectivity. In the January 1955 issue he reviews the Goldring "500" Pickup. An abbreviation of his article is reprinted, with full acknowledgment, below.*

"This latest Goldring Cartridge, No. 500, has an exceptionally long frequency range, and I have not been able to detect any non-linear distortion even on records of large amplitude. Its design, indeed, seems to have solved all the problems which some of us encountered when we made our moving-iron pickups in prewar days.

Here are the details as given in the makers' list:

Specification:

Type: Magnetic Reluctance Turnover Cartridge.
Styli: (1) 0.0025 in. rad. sapphire or diamond for 78's.
(2) 0.001 in. rad. sapphire or diamond for LP's.
Normal tracking pressure: 7 grams.
Lateral Compliance: Better than 3 × 10-6 cm/dyne.
Effective mass at stylus tip: 3.5 milligrams.
Output (average): 3.2 mV per cm/sec. (on loud record) 35 mV.
D.C. Resistance: 1500 ohms.
Impedance at 1000 c/s: 3800 ohms.
Recommended load resistance: 50,000 ohms.
Frequency response: Substantially linear from 20 to 16 kc/s (and to over 20 kc/s on shellac discs).

The cartridge encloses a permanent magnet with two sets of pole pieces embraced by a common twin-coil system. Two poles are on one face and operate with an "armature" of cantilever type to produce tiny electric signals from 78 r.p.m. records. Two other pole pieces are on the opposite face and are used in conjunction with a separate cantilever armature and a stylus for LP records. There are no moving parts common to the two uses and therefore there is no unnecessary mass. So the H.F. resonance of each system can be kept high. This is a tremendous boon, and means that with this design all the convenience and cheapness of a turnover cartridge can be secured without any disadvantage whatsoever.

The freedom from non-linear distortion has been secured by having an exceptionally large gap between the pole pieces and by having no unbalanced damping on the armature. For this advantage, of course, a price has to be paid in the way of sensitivity. Still, an output of 3.2 millivolts per cm/sec. is sufficient to load an amplifier plus pre-amplifier system, such as the Pye, or Pamphonic or Quad II or Leak without the use of a transformer. Notwithstanding the low output voltage and comparatively high working impedance load, the hum voltage is remarkably low, owing to the balanced (push-pull) coil system. This way of avoiding hum from stray magnetic fields is a valuable feature of the design. Electro-static hum is comparatively easily avoided by the use of careful screening; but electro-magnetic hum can be the very devil.

The cantilever armatures carrying the styli on each side of the cartridge are quite tiny affairs. They are not mechanically damped in any way and so the freedom of motion is exceptionally high. On the other hand, this also means that the high-note resonance is undamped. There is thus a small peak (it really is very small) in the region of 13-14 kc/s for LP records and 20 kc/s for shellac discs. This peak is barely detectable in actual playing conditions even with the most difficult records; and I have found that it is possible to remove it almost completely by painting the cantilever very lightly with a solution of soft p.v.c. (or viscaloid) in chloroform.

I apologise to the more unversed amongst my readers for being so technical and formal. My excuse is that it is quite an occasion to have a pick-up of so interesting and successful design to analyse. It is not very long ago that I should have been very sceptical about the possibility of making an electro-magnetic pickup of such a calibre, and particularly one embodying the cantilever principle with all the advantages of high vertical as well as lateral compliance. Well, here it is and at a remarkably cheap price; and, I should think, with this particular style of design carried about as far as it could very well go.

The cartridge can easily be mounted in one of the pickup heads that are usually used in this country for turnover pickups.

1. The output of the 500 is comparable to that of the moving-coil type, but its impedance is higher. It is therefore rather more senstiive to electrostatic hum; I have, however, found no difficulty in obtaining adequate screening. On the other hand, it is much less sensitive to electromagnetic hum.

Its price is, of course, much lower than that of any good moving-coil pickup.

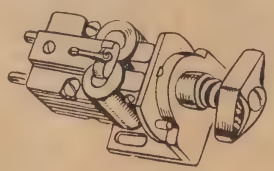
2. The stylus compliance is greater than that of even the best crystal pickup, though its output is much less. Its price is about the same.

Its performance is hardly affected by temperature changes as is Rochelle Salt. It is therefore particularly suitable for tropical countries, whereas Rochelle Salt loses its properties at about 50 deg. C. (120 deg. F.). No Ceramic pickup I know of as yet can equal it in performance, except as regards output

3. It is less susceptible to non-linear distortion (and electro-magnetic hum) than other designs of moving-iron pickups at present available, and its useful frequency range is longer. Its lateral compliance is greater and its vertical compliance much greater. It will therefore track comfortably at smaller stylus pressure. Most other types I know of have not the advantages of cantilever mounting or of innocuous turnover facilities.

4. It is not dependent for its good performance on the quality of the pivoting of the moving parts or damping arrangements. Apart from accidents, therefore, its performance is likely to stay put.

Since I wrote the foregoing I have received a copy of letterpress and curves which are being printed in the new Goldring "Service Notes" for operating the 500 pickup. I warmly commend them. I know of no other pickup for which such full technical and practical details are given."



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Using this arrangement, we found it possible to employ a 0.25 meg. input gain control, without introducing any great degree of error. What error there was could be reduced in magnitude, without complication, by a very small bypass across the "hot" end of the potentiometer.

The effectiveness of the approach is shown by the dashed curve in figure 6, representing the maximum loss position and by the dotted curve, representing a setting where overcompensation could easily occur. The face that both curves are below the fundamental response of the amplifier indicates that slightly more top-end bypassing could actually have been used.

CONSTRUCTIONAL

Physical changes to the original 5in Oscilloscope are not very extensive. The present vertical amplifier wiring needs to be stripped out and the front 7-pin miniature socket moved back to the vacant valve-hole behind its mate. A new shielded and preferably sprung-type 7-pin miniature replaces it.

It is wise also, at this stage to strip out the vertical deflector plate leads and pass them up through a grommeted hole to the top side of the chassis. Run them in stiff spaghetti-covered busbar to a tag-strip beneath the base of the CRO tube and thence up to the socket by flexible leads.

Do not twist these leads or strap them closely together, otherwise the high frequency response will suffer by capacitive shunting.

The purpose of running the leads above the chassis is to prevent high-amplitude, high-frequency signals from coupling into the time-base.

The two rear 6AU6 sockets can now be wired up as the push-pull deflection stage, keeping the relevant components adjacent to the sockets. A tagstrip will provide the necessary tie-points and a mounting position for the decoupling network.

The connections from the two plates to the coupling capacitors behind the panel are best made with spaghetti-covered busbar, running close to but not hard against the side of the chassis.

GRID WIRING

In wiring the first stage, turn the grid so that it is furthest away from these output leads. Needless to say, the grid must be connected to the pot by a direct, unshielded lead.

This unfortunately, invites instability with open input terminals and you may find it necessary to instal a small shield plate between the deflection terminals and the vertical amplifier input terminal.

If need be, the input terminals can be swapped over, the red "active" terminal changing places with the black "earthy" one. Note that the input coupling capacitor has been increased in value to 0.5 mfd.

Using an 0.25 meg. pot. the input impedance should be sufficiently high to allow routine testing of most amplifier circuits, with full frequency response irrespective of pot. setting.

In odd cases, where a higher input impedance is required, it will be necessary to connect an 0.5 or 1.0 meg. resistor in series with the probe, making due allowance for deterioration in response which this will bring about.

ELEMENTARY BINARY ARITHMETIC

In articles about counters and computers, the word "Binary" occurs very frequently. But what does it mean? In this article, Engineers of the Aerovox Corporation explain the principles of Binary Arithmetic from which the term is derived.

WITH the growing presence of digital electronic computers among us, more and more radio technicians are beginning to hear obliquely about the binary number system and wonder why they have learned nothing about it before.

There is good excuse for the perplexity, since surprisingly little has appeared on the subject in the books and magazines customarily read by radio men. Many technicians, who have prided themselves on being reasonably well grounded, have thumbed through mathematics textbooks, old and new, and found no reference whatever to the binary system!

WHAT IT MEANS

A glance into the dictionary reveals the word binary to mean "characterised by two things or parts". From this, we may infer, correctly, that binary arithmetic is in some way associated with the figure 2.

Indeed, the binary system uses only two digits. Now, let us see how this differs from the method of counting we have employed most of our lives.

Our old standby is the decimal system. Its base is 10 and its digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. This is very handy because we have 10 fingers on which to count.

In our civilisation, we have got along famously with the base 10. It is possible to express any number by the proper combination of the digits 0 to 9.

However, when we attempt to set up some forms of electrical counting equipment in strict accordance with the decimal system, we find ourselves in need of a multitude of components.

Here, the binary method comes to our rescue. It is a base 2 system and requires only two digits: 0 and 1. In the binary system, all numbers can be expressed by combinations of zeros and ones.

WHY USEFUL?

Just why should this be handier than the decimal system? Simply because it is an easy matter to express the binary digits themselves with a simple electrical device which is either ON (1) or OFF (O). Thus, an open switch or relay denotes zero, while a closed switch signifies 1.

The same is true of a tube conducting or cut off, a crystal diode conducting or blocking, a neon lamp ignited or extinguished, &c. A voltage or current likewise can denote 1 when high or positive, and zero when low, negative, or off. The binary system operates with fewer and simpler components.

Although a certain piece of equipment, such as a counter, might operate by the binary method, it still can be made to give indications (such as total count) in the easily-recognised decimal notation.

TABLE I.

DECIMAL NUMBER	BINARY NUMBER
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010

In explaining the elements of binary arithmetic in this article, frequent comparisons will be made with the decimal system for the sake of clarity or proof.

Supposing you have four separate on-off components (switches, tubes, &c.), each of which is assumed to indicate zero when OFF and 1 when ON. Table 1 shows how the two states of these same four devices can be employed to express various decimal numbers.

In order better to understand this table, let us consider the basic rules of binary addition which may be stated as follows: $0 + 0 = 0$, $0 + 1 = 1$, $1 + 0 = 1$, and $1 + 1 = 10$. This last sum means simply that every time 1 is added to 1, we write down zero and carry the 1 to the next column to the left.

An illustration will serve to clarify binary addition. For example, from Table 1 add 0101 (binary 5) and 0011 (binary 3):

BINARY	DECIMAL
0101	5
+ 0011	+ 3
1000	8

1.

First, the two 1's in the right-hand column are added. This equals 10, so we write 0 and carry 1 to the next column to the left. This 1 must be added to the 1 already in that column. Again, this equals 10, so we write 0 and carry 1 to the next column to the left. Adding this carried 1 to the 1 already in that column gives another 10, so we write another zero and carry 1 to the leftmost column. Now, this 1 is added to the zero in that column, giving 1 which is written.

The answer is 1000, which by reference to Table 1 is found to be binary 8.

A careful examination of Table 1 now reveals that each higher binary number is obtained by adding binary 1 (0001) to the preceding number.

TABLE II.

2^0 1	2^{13}....8192
2^1 2	2^{14}....16,384
2^2 4	2^{15}....32,768
2^3 8	2^{16}....65,536
2^4 16	2^{17}....131,072
2^5 32	2^{18}....262,144
2^6 64	2^{19}....524,288
2^7 128	2^{20}....1,048,576
2^8 256	2^{21}....2,097,152
2^9 512	2^{22}....4,194,304
2^{10}....1024	2^{23}....8,388,608
2^{11}....2048	2^{24}....16,777,216
2^{12}....4096	2^{25}....33,554,432

Positive Powers of 2.

TRY IT OUT

Try this out by starting with 1010 (binary 10) and successively adding 0001 (binary 1). You will obtain 1011 for 11, 1100 for 12, 1101 for 13, 1110 for 14, and 1111 for 15.

If you make another addition, you will obtain 10000 (binary 16) which requires five on-off devices for its expression—and we agreed at the beginning that we have only four. So binary 15 is as high as a 4-device system will count.

However, the economy and efficiency of the system is realised when it is considered that only four elements are needed to display from 0 to 15 events.

Any number may be expressed in the binary system by choice and

For example: The decimal number 2548 means $2 \times 10^3 + 5 \times 10^2 + 4 \times 10^1 + 8 \times 10^0$. Similarly, the binary number 011010 means $0 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$.

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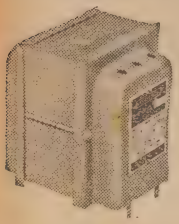

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PF 151	230-240	285	60	6.3V/2A 5V/2A
PF 151F	230-240	285	60	6.3V/2A 5V/2A
PF 152	230-240	285	125	6.3VCT/2A 6.3V/2A 5V/2A
PF 165	230-240	385	60	6.3V/2A 5V/2A
PF 170	230-240	285	80	6.3V/2A 6.3V/2A 5V/2A
PF 185	240	150	30	6.3V/2A
PF 201	240	225	50	6.3V/2A
PF 265	230-240	Secondary Volts		17 TAP 11.5, 10, 8.5/4.2A
PF 209	240	285	40	6.3V/2A 5V/2A

POWER TRANSFORMERS SECOND PREFERENCE

CODE NO.	PRIMARY VOLTS	HTV ASIDE	H.T. MA	FILAMENTS
PF 160	230-240	385	100	6.3V/2.5A 6.3V/2 5V/2A
PF 164	230-240	325	100	6.3VCT/2A 6.3V/2A 5V/2A
PF 166	230-240	325	60	6.3V/2A 5V/2A
PF 168	230-240	385	80	6.3V/2A 6.3V/2A 5V/2A
PF 169	230-240	325	80	6.3V/2A 6.3V/2A 5V/2A
PF 173	230-240	425	175	6.3VCT/3A 6.3V/2A 5V/2A
PF 174	230-240	285	150	6.3VCT/2A 6.3V/2A 5V/2A
PF 175	230-240	385	150	6.3VCT/2A 6.3V/2A 5V/2A
PF 345	240	Ext. 1000	2	6.3V/3A 6.3V/6A
		350	20	4V TAP 2.5/2A
PF 439	240	30V	60	240-32 STEPDOWN

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CF 111	16	165	200
CF 112	10	70	250

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CODE NO.	WATTS	PRIM Z	SEC. Z.	RESPONSE
OP 9	15	10,000, 6600, 5000 PP	500, 250, 125	50-8000 C/S
OP 13	25	10,000, 6600, 5000 PP	500, 250, 125	50-8000 C/S
OP 24	5	5000 SE	8.4 OR 2.1	30-15,000 C/S
OP 25	15	10,000 PP	15-3.7 OR 8.4-2.1	20-30,000 C/S
OP 44	10	5000-2500 SE	500, 250, 125	50-8000 C/S
OP 54	10	5000-2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	50-8000 C/S
OP 58	15	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	50-8000 C/S
OP 63	15	10,000 PP	15, 3.75	30-15,000 C/S
OP 112	6	10,000 PP	2, 8 SUIT ROLA 120 x	40-12,000 C/S
OP 113	6	5000 SE	2, 8	40-12,000 C/S
OP 118	6	8000 PP	2, 8	40-12,000 C/S

OUTPUT TRANSFORMERS SECOND PREFERENCE

CODE NO.	WATTS	PRIM Z	SEC. Z	RESPONSE
OP8M	15	10,000 PP	500, 250, 160, 125, 100, 83.5, 7.5, 62.5, 55, 50	50-8000 C/S
OP 17	32	10,000, 6600, 5000 PP	500, 250, 125	50-8000 C/S
OP 19A	15	5000 PP	12.5, 8, 2.3	30-15,000 C/S
OP 65	15	10,000 PP	8.4, 2.1	30-15,000 C/S
OP 67	15	5000 PP	15, 6.5	20-30,000 C/S
OP117	6	5000 PP	8, 2	40-12,000 C/S
OP119	6	6600 PP	2, 8	40-12,000 C/S
OP 60	32	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2, 2.7, 2.3, 2.	50-8000 C/S

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CODE NO.	PRIM VOLTS	D.C. VOLTS	O'PUT MA	BUFFER FULL SEC.
VT 116	24	250	60	.005
VT 208	6	250	60	.01
VT 209	12	250	60	.08
VT 211	32	250	60	.005H

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position of the two digits repeated as coefficients of powers of 2, just as any number can be expressed in the decimal system by choice and position of the ten digits of that system as coefficients of powers of 10.

Table II lists the powers of 2 up to the twenty-fifth and you can obtain from this table the decimal numbers corresponding to the powers of 2 given in the preceding example.

Adding these discloses that 011010 equals 26:

$$
\begin{aligned}
0 \times 2^5 &= 0 \\
+\ 1 \times 2^4 &= 16 \\
+\ 1 \times 2^3 &= 8 \\
+\ 0 \times 2^2 &= 0 \\
+\ 1 \times 2^1 &= 2 \\
+\ 0 \times 2^0 &= 0 \\
\hline
011010 &= 26
\end{aligned}
$$

2.

You can prove this sum by returning to Table 1 and adding binary 1 (0001) successively to binary 10 until you reach 011010, which you will find equal to 26.

BINARY POINT

A binary point is used in binary notation just as a decimal point is used in decimal notation. An example is 100101.01 with six digits on the left and two on the right of the binary point, although the digits might increase in number without limit on both sides of the point.

We have already seen that the digits on the left of the point are coefficients of increasing positive powers of 2, with 2 to the power zero adjacent to the Binary point.

The digits on the right are coefficients of increasing negative powers of 2, with 2 to the power minus 1 adjacent to the point.

The example just given (100101.01) becomes:

$$
\begin{aligned}
1 \times 2^5 &= 32 \\
+\ 0 \times 2^4 &= 0 \\
+\ 0 \times 2^3 &= 0 \\
+\ 1 \times 2^2 &= 4 \\
+\ 0 \times 2^1 &= 0 \\
+\ 1 \times 2^0 &= 1 \\
+\ 0 \times 2^{-1} &= 1 \\
+\ 1 \times 2^{-2} &= 0.25 \\
\hline
100101.01 &= 38.25
\end{aligned}
$$

3.

ADDITION AND SUBTRACTION

The addition of postive numbers in the binary system already has been explained in the preceding paragraphs. While the addition of two numbers has been given in each illustration, the system is by no means restricted to 2-number groups. Any series of binary numbers can be summed.

The only remaining case is the addition of a positive and a negative number. Consider, for example, the addition of 0101 and —0010.

DECIMAL	BINARY
5	0101
—2	—0010

4.

The technique is to change the sign of the negative number, then complement this number, and add the result to the positive number.

To complement the number, change each of its 1's to 0's and each of its 0's to 1's and add 1. Thus minus 0010 becomes: 1101 plus 1 equals 1110. Now if we add:

$$
\begin{aligned}
&0101 \\
+\ &1110 \\
\hline
&10011
\end{aligned}
$$

5.

Here, the left-most digit in the answer is discarded. If it is 1, the sign of the answer is positive, as in the above case. The answer thus is plus 0011, or binary 3, which satisfies the condition of 5 minus 2 equals 3.

If the left-most digit is zero, the sign of the answer is negative and the result must be recomplemented (the same process as the original complementing) to give the correct answer. This always happens when a negative number is added to a smaller positive number. Thus: Add minus 1000 (binary 8) to 0011 (binary 3):

$$0011 + (-1000) = 0011$$
$$+\ 1000 = 01011$$
$$-1000$$

complemented

6.

Dropping the left-most 0 in the answer (which merely indicates the negative sign), and recomplementing changes 1011 to minus 0101 (binary 5), which is the correct answer: Minus 8 plus 3 equals minus 5.

Subtraction is the same as the addition of positive and negative binary numbers, as just described. For example: Subtract 0100 (binary 4) from 1010 (binary 10). 1010 minus 0100 becomes 1010 plus 1100 when the negative number (subtrahend) is complemented, and its sign changed. This equals 10110. The left-most digit, being a 1, indicates that the sign of the answer is positive and is discarded, making the answer plus 0110 (binary 6), which is correct.

MULTIPLICATION

Binary multiplication is carried out in very much the same manner as decimal multiplication, obtaining partial products in the conventional manner, but adding the latter in binary fashion. In binary multiplication, 0 x 0 equals 0; 0 x 1 equals 0; 1 x 0 equals 0; and 1 x 1 equals 1.

As an example, multiply 0101 (binary 5) by 0010 (binary 2).

$$
\begin{aligned}
0101 &= 5 \\
\times 0010 &= \times 2 \\
\hline
0000 & \quad 10 \\
0101 & \\
0000 & \\
0000 & \\
\hline
0001010 &= 1010 = 10
\end{aligned}
$$

7.

DIVISION

Binary division is carried out in a manner similar to decimal division, as the following example will show: Divide 1001 (binary 9) by 0100 (binary 4).

$$
\begin{array}{r}
10.01 = \text{ans.} \\
0100 \overline{)\ 1001} \\
100 \\
\hline
000100
\end{array}
$$

The quotient 10.01 =

$$
\begin{aligned}
0 \times 2^1 &= 0 \\
+\ 0 \times 2^2 &= 0 \\
+\ 1 \times 2^1 &= 2 \\
+\ 0 \times 2^0 &= 0 \\
+\ 0 \times 2^{-1} &= 0 \\
+\ 1 \times 2^{-2} &= 0.5 \\
\hline
10.01 &= 2.5
\end{aligned}
$$

8.

After studying the rudiments of binary arithmetic presented here, the reader should be able, by setting up for himself a number of practice examples for drill, to acquire considerable proficiency in manipulating this invaluable new tool. A good working knowledge of the binary system is essential to comprehending the operation of digital electronic computers and of other instruments, such as counters, which utilise the digital techniques.

Atom tactics

THE Australian Army was preparing for atomic warfare, according to Lieut.-General Sir Sydney Rowell, chief of the General Staff.

Tactics for atomic warfare would take two or three years to evolve.

Sir Sydney said the main problems the army would have to overcome would be:

The greater destructiveness of atom-bombs which prevented battlefield concentrations of troops.

The need for increased battlefield mobility because of the inevitable damage to communications.

The need for more individual commanding authority with commanders of all grades.

Greater simplification of administration.

He said the huge Normandy invasion and El Alamein concentrations were classic examples of what must be avoided.

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by John Moyle

THE general requirements for a mantel receiver are few and simple. They are the ability to receive local stations with enough volume to be heard clearly in an ordinary room, an appearance which will blend with modern furnishings, and a cost as low as is consistent with reasonable quality.

From the engineer's point of view, these requirements lead almost inevitably to a standardised answer. There isn't much choice about the type of circuit he must employ. Experience has taught him that there are certain irreducible minimums which he cannot cut down without risk, and an upper limit on complication and components beyond which cost will be too high.

The net result is a receiver with a circuit still reminiscent of the "Little General", which sky-rocketed into fame before the war when first described in RADIO AND HOBBIES.

Valves have been improved since then, and made smaller. Tuning coils and intermediates now give higher performance and take up less space.

But we still have the converter, IF stage at 455 Kc, and output valve driven from detector diodes which were the basis of the Little General design.

If circuits have become standardised, cabinets have not. A study of any radio dealer's window in which a variety of makes is displayed shows a very great difference between one and another. And yet each reflects someone's idea of what the public will like, whether it is his own or something copied from an overseas design.

The popularity of mantel sets is so great that today about the only other type in steady sale is the radiogram. The console set as we knew it before the war has almost completely disappeared, and although a big seller in England and Europe, the in-between "table" model radio hasn't gone over here in Australia.

CASE FOR MANTEL

This trend is not surprising when we remember how much radio has has become an everyday commodity in our lives, and the type of material which has settled down to steady favor in public acceptance.

Sporting fixtures, particularly horse racing, account for an enormous proportion of Australia's total listening time. Serials and soap operas would compete very strongly for first place and if we add quiz sessions and popular shows of this nature, we have included pretty well the entire radio diet of many people.

One does not need an elaborate radio set for this kind of reception and, in the average suburban areas on Saturday afternoons, many would fervently support any move for mantel set use as opposed to a hefty radiogram so often heard booming halfway down the street!

It is only to be expected, therefore, that a cheap receiver which can be conveniently parked on a mantelpiece, a table, or a kitchen cupboard will be in great demand.

It follows, too, that competition in the field of mantel sets is very keen. Every trick of the trade has been and is being exploited to attract buyers' attention, and some of the finished products are most attractive.

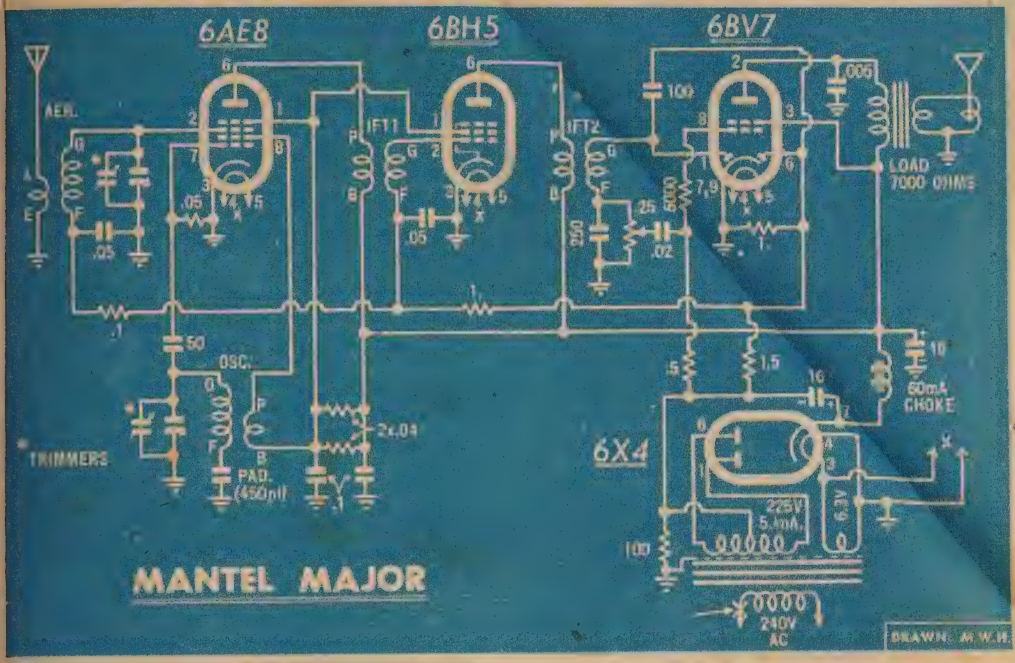
PLASTIC CABINETS

Probably the most valuable asset to the small set designer has been the plastic cabinet, which, right from the time of its first use, was destined to wipe the wooden article from the scene.

Plastic cabinets can be made in shapes and sizes which would be far too costly for any other medium. Moreover, there is an infinite variety of color schemes, many of which are exceptionally effective, and which need no extra processing to achieve.

The very flexibility of the plastic

CIRCUIT OF MANTEL MODEL IS EXTREMELY SIMPLE



The circuit is the essence of simplicity. For minimum residual hum a 25 mfd electrolytic may be connected across the 100 ohm back bias resistor, positive terminal to the chassis.

medium is almost a danger to designers, who at times tend to lose themselves in elaboration, both in shape and in ornament.

But there are many cabinets which are almost classical in their use of balance and design.

Unfortunately plastic cabinets are not economical unless produced in large numbers. The initial cost of die-making is high, and although the processing cost is quite moderate, it needs a large "run" to capitalise on the advantages of the moulding process.

We have always been restricted as far as small sets are concerned by the lack of plastic cabinets such as are at the disposal of the set manufacturers.

STANDARD TYPE

It is quite true that wooden, covered cabinets have been produced for our designs which are extremely attractive and serviceable, as evidenced by the large numbers which have been sold. In fact, manufacturers of these cabinets have developed a styling with considerable eye appeal.

Nevertheless we have always been on the lookout for a plastic cabinet which would be suitable for housing sets built at home, good enough to compete with factory made designs, and if possible with a character of its own.

A few months ago we were considering a cabinet made by Aegis for use with extension speakers—an attractive job meant to accommodate a standard 8in speaker. It suddenly occurred to us that the base of the cabinet would be quite large enough to house a mantel set chassis which could be used with such a speaker, and which for volume and tone might well outperform most mantel sets available at the present time.

Because of the standardisation in circuit design already mentioned, there seemed no difficulty in producing a chassis which would measure up to modern standards of performance, as many of our mantels have done in the past.

It wasn't long before we had evolved a suitable layout to accommodate the necessary components and in a few days we had put it together.

The result is described in this article, and it has fully measured up to our anticipations.

PARTS LIST

1 Chassis 11¼" x 3¾" x 1".
1 Power transformer 220V at 50mA. 6.3V at 2A.
1 Filter choke 60mA.
1 2-section ganga MSP.
2 4-70pf trimmers.
1 Coil Kit miniature type-Aerial coil, Oscillator coil, 2 IF's at 455Kc.
1 8 inch speaker with 7000 ohm transformer.

SOCKETS

3 Novals, 1 7-Pin miniature.

VALVES

1 6AE8. 1 6BH5. 1 6BV7. 1 6x4.

CAPACITORS

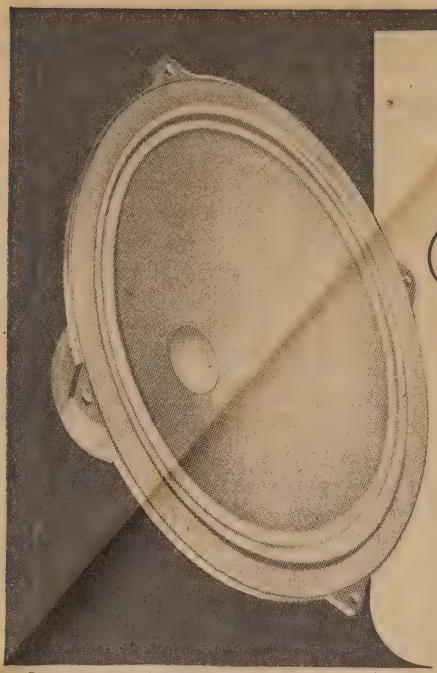
2 16 mfds 350Pv electrolytics, 2 .1 mfd 2 .05 mfds, 1 .02 mfds, 1 .005 mfds all tubulars not lower than 300 volt rating. 1 450 pf padder 2½%. 1 250 pf, 1 100 pf, 1 50 pf all mica.

RESISTORS

1 1.5 meg, 2 1 meg, 1 .5 meg, 1 .1 meg, 1 .05 meg, 1 5000 ohm all ½ watts. 2 .04 meg 1 watt, 1 100 ohm 1 watt. 1 .25 meg potentiometer with switch

SUNDRIES

2 1½ inch Knobs with special scales (see text).
3-core power flex and plug. 1 aerial terminal.
3 5-point tag strips, 2 ½ inch grommets, 2 ⅝ inch grommets. Hookup wire, solder lugs, solder, nuts and bolts ⅛ inch etc.



Magraths

NOW HAVE NEW STOCKS OF

W B Stentorian

HIGH FIDELITY UNITS

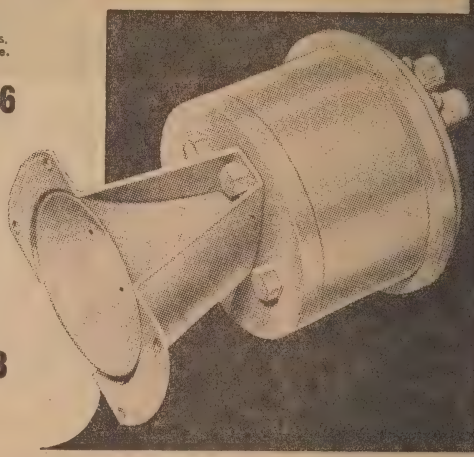
Our record of achievement in loudspeaker design covers more than 25 years, and includes many notable improvements. Now, with new supplies of the Stentorian range of High Fidelity Units, we can offer a quality of performance that is unmistakable and inimitable, at a cost which compares favourably with similar-sized units selling at popular prices. This new range has been developed to provide reproduction that takes full advantage of the television sound transmissions and high fidelity recordings now available. The cone of the loudspeaker is made from uncured cambric and bonded pulp, the whole being completely cured together and made into one composite cone by a new manufacturing process.

The bass resonance of the loudspeaker is substantially lower than that using the conventional cone, and all colouration is therefore removed from the lower frequencies. No tiring or fatique of the surround takes place. The high frequencies are well maintained which, together with the extended bass response, provides a well-balanced overall response.
The loudspeakers are all fitted with high flux density Alcomax magnets and are completely dustproof.

For sensitivity, smoothness and vivid realism these new models worthily uphold a fine tradition. Try one yourself and hear the difference.

Above: 10in with 35 c.p.s. Cambric Cone.
HF1012
£6/19/6

Right: Tweeter.
T10
£8/9/3



MODEL H.F. 1012: 10in Die-cast unit, incorporating 12,000 gauss magnet. Handling capacity:- 10 watts. Frequency response: 30 c.p.s.—14,000 c.p.s. Bass resonance: 35 c.p.s.

MODEL T.10: We are constantly receiving enthusiastic reports about this outstanding Unit which can be used with any cone speaker. A very high standard of reproduction is obtained when it is used in conjunction with the Stentorian 10in P.M. Speaker (type H.F.1012).

The unit is of the moving coil pressure type and is similar to that embodied in the 10in and 12in Concentric Duplex Loudspeakers. The speech coil is of aluminium wire, wound on an aluminium former which is rigidly fixed to an aluminium diaphragm. The speech coil and the diaphragm are situated at the rear of the magnet and the centre pole hollowed out to form the commencement of the Horn, in the centre of which is located the phase equaliser.

★ Speech coil impedance: 15 ohm.
★ Response: 2000/14000 c.p.s.
★ Flux density: 14000 gauss.
★ Power handling capacity: 3 watts.
★ Dispersion angle: 90 deg.
Dimensions: 4½in long (exclusive of terminals); distance between fixing holes: 2½in and 1½in.

★ FURTHER SUPPLIES ALSO AVAILABLE OF THESE STENTORIAN UNITS.

HF12135 ..... **£21/15/9** T12 Tweeter **£23/6/9**

Australian Agents:—

J. H. MAGRATH & CO. PTY. LTD. 208 LT. LONSDALE ST., MELB., C.I., VIC. FB3731

SPEEDY MAIL ORDER SERVICE

In the matter of size, the cabinet isn't as small as the smallest mantel sets, and yet it isn't large enough to be bulky. A very small set is a dinky little thing, but it has serious disadvantages.

By far the most serious in our opinion is the necessity for using a small speaker.

In general, the performance of a speaker deteriorates rapidly with its size. The 3in type such as we are forced to use in very small sets is a miracle of manufacture, but we wouldn't deliberately choose one if we could possibly avoid it. Present day 5in types have been vastly improved in both sensitivity and tone. But neither is a serious competitor with the 8in speaker on any count, and no one could fail to be impressed with its superior performance when used with even the most modest of receivers.

8-INCH SPEAKER

The most striking improvement will be noticed on music, where the 8in cone not only produces better bass response (if we can consider any mantel set as a producer of bass!) but greater clarity of speech. The reproduction in general has a roundness and a weight which it is impossible to match with smaller speakers, and the larger cabinet face represents a very much better baffle to make the most of the larger cone area.

So that in assessing the value of the Aegis cabinet, we considered its extra bulk far outweighed any advantages which might go with a cabinet two-thirds its size.

At first glance, it might be wondered where one could tuck away a complete receiver chassis in a cabinet, the entire face of which is virtually taken up with the speaker.

It has been done quite easily by abandoning any kind of tuning dial as we know it, and using instead a large knob driving directly to the tuning capacitor shaft. A second knob of similar dimensions operates the volume control, and both are fitted with indicator plates attached directly to the face of the cabinet.

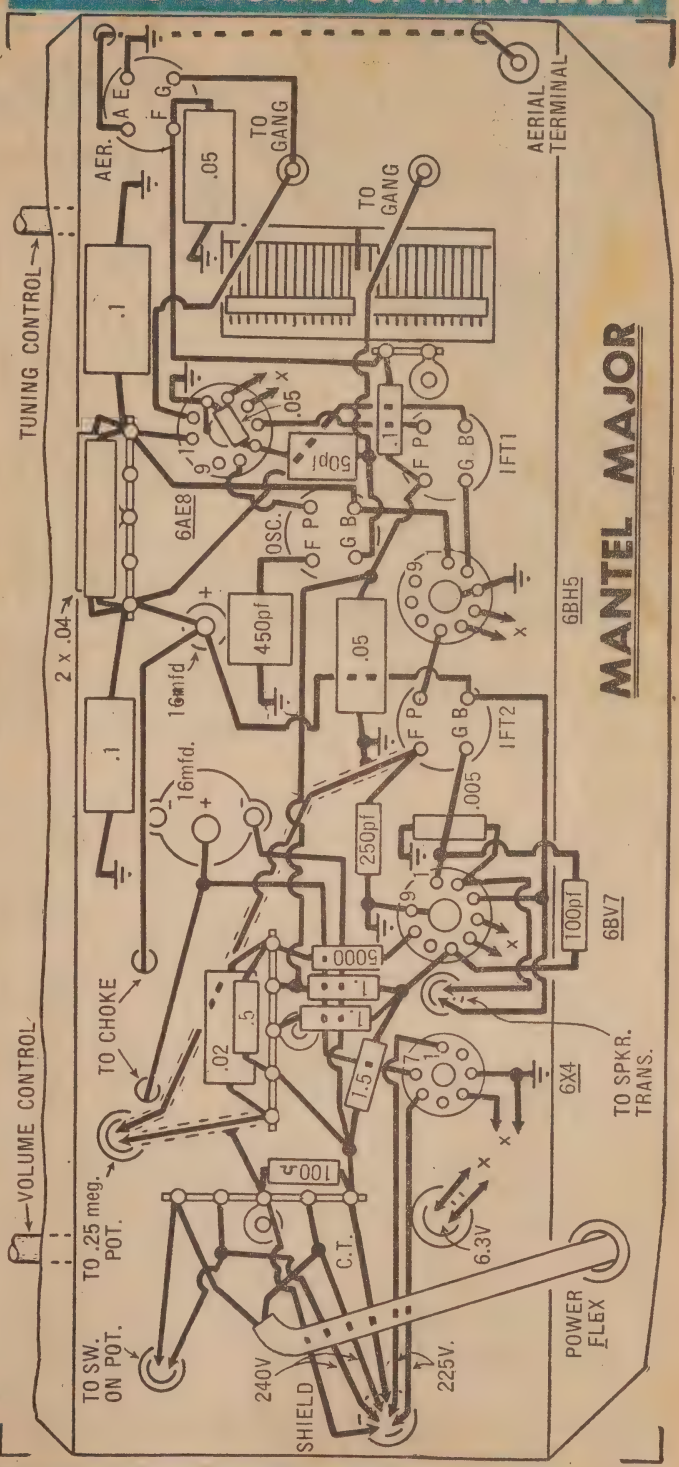
TUNING DRIVE

The use of direct drive for tuning isn't really a disadvantage. It is quite impossible to use a large speaker if most of the cabinet face is taken up with a conventional dial, and if the dial is a small one, it is equally impractical to include a full range of station markings on the glass. In any case, these are rarely needed, as most mantel sets are mainly for use with local stations, of which there are not more than eight in any capital city. Our indicator plate can quite easily include this number.

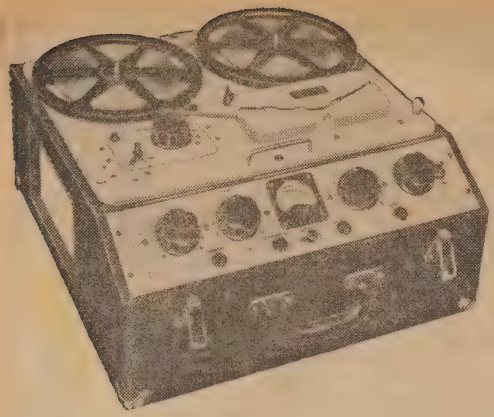
Nor is the vernier action essential for local station tuning. Provided a large knob is used, it isn't at all hard to locate the local stations quite accurately and quickly.

We have invited the opinion of many people on this point, including radio men and ordinary set users,

WIRING DIAGRAM OF MANTEL SET



This complete wiring diagram makes construction a simple matter.



Synchronous Capstan motor. Improved response and signal-noise ratio. Simplified speed change. Provision of 1,750 reels i.e., 45 minutes interrupted playing time per track at 7½in per second and 1½ hours per track at 3¾in. More convenient unit form for portability. Lighter in weight. Provision for Superimposition.

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Tape Recording Equipmen

On its introduction six years ago the Ferrograph se standard in magnetic tape recorders that has remain the target of all subsequent designers. Now re-styl Model 2A/N is presented in a physical form worthy its technical excellence.

Basically the same robust, time-proven and reliable strument, the new model 2A incorporates many refi ments and facilities requested by discriminating Fer graph owners and users.

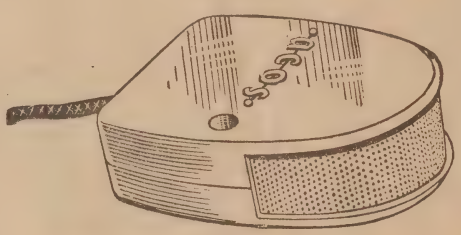
No fantastic or exaggerated claims are made for Ferrograph—indeed none are needed. Its reputation the United Kingdom and abroad is such that it is ju denominated the standard by which all others are judg

Used by Broadcasting Authorities throughout the world

UNITED RADIO DISTRIBUTORS PTY. LTD

Radio-Electric Wholesalers 175 Phillip St. Sydney. BL3954 (3 lines)

SOLE AUSTRALIAN AGENTS: TAPE RECORDERS PTY. LTD., 183 PITT STREET, SYDNEY.



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ACOS MIC 35 (HAND AND/OR DESK TYPE)

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A general purpose microphone with high sensitivity and substantially flat characteristic. Housed in attractive Die Cast Case of very robust construction is particularly suitable for use in recording apparatus — Public Address Equipment — Dance Bands — and similar applications.

Provided with built-in shunt resistance of 2 megohm giving response substantially flat from 50/5,000 cps. Resistance of the input circuit will reduce the low frequency response. A grid leak of ½ megohm will reduce the output at 500 cps by 3 dbs and pro rata at lower frequencies.

Approximate capacitance of the microphone is 750pF and cable capacitance will reduce output proportionately.

Frequency response	Substantially flat from 50/5,000 cps.
Output level	= 55 db ref. 1 volt/dyne/cm2.
Load resistance	2 megohms included.
Cable	This microphone is supplied with approximately 4ft. 1.2 metres of co-axial cable (type Unirad 32).
Weight	Microphone only — 6oz. (approx. 170 grammes) complete with packing 7oz. (approx. 198 grammes).
Dimensions	Microphone only 2 7/8in x 2 1/8in x 7/8in plus cable. Complete with packing 3 3/8in x 2⅜in x 2⅜in.

Australian Agents: AMPLION (A'sia) PTY. LTD., Sydney, N.S.W.

hd none has found any difficulty lith tuning. Direct drive tuning not nly cuts down on waste space, but aves on initial cost, for even the implest tuning dial is comparatively expensive.

The knobs to use are also made y Aegis and are 1½in in diameter. 'd go with them will be produced a. air of discs which are centred over he control shaft holes and bolted o the cabinet with ordinary 1/8in ountersunk bolts.

The inscriptions on the discs are nade by transfers which are being rovided, so that the tuning indiator disc may be marked for stations n the major capital cities, or with scale showing tuning in Kc whichver is preferred.

The second disc will be appropriately inscribed to indicate its unction as a volume control.

When the set was photographed, ve were using our own hand-lettered cales, but Aegis advise that their ransfer set will be available by the ime this issue is on sale.

The cabinet and knobs, incidentlly, will be obtainable initially in wo colors—cream and walnut, alhough if the demand justifies it, ther colors many become available.

HANDSOME SET

The finished job as our photograph hows, is a really handsome little et, and has been greatly admired for ts simplicity and performance. Being only a little over 4in deep, it an really sit on a mantel-piece, even the narrow ones found in many nodern homes, while it is equally ppropriate in almost any other seting. Quite literally it is a mantel et with a difference.

You will need to drill two holes or the control shafts, and you should take care to balance these for symmetry. They are 1 7-8in rom the bottom edge of the cabinet, nd 1⅜in in from the sides. Take your time over the location of these noles, although the knobs and indicator plates will cover up quite a arge error.

The main thing is to see that the noles are drilled as nearly as possible to these dimensions to achieve a balanced appearance, and that they exactly match on each side. The position of the gang and the small oracket supporting the volume control will control this point.

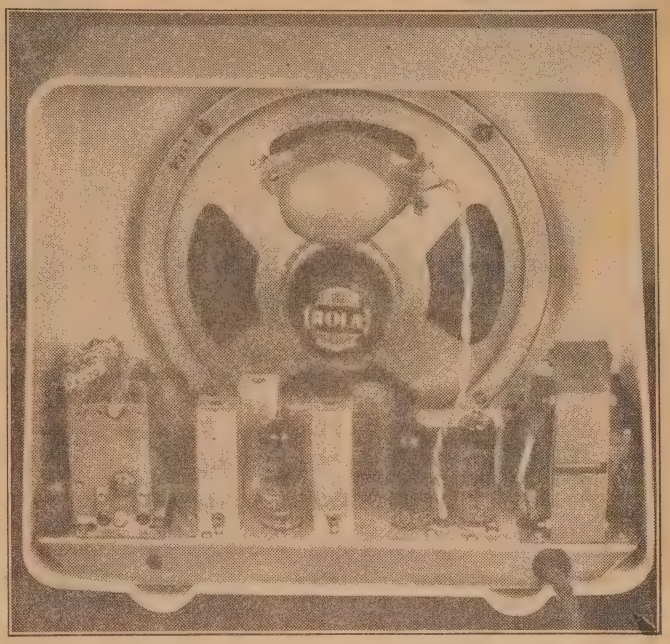
The set is very easy to build—it is doubtful whether we have ever described one in which all the parts are so accessible. The chassis is in the form of a longish, narrow dish with the large components all mounted above the chassis.

CHASSIS LAYOUT

In order that the controls shall be balanced, one at each side of the cabinet face, the tuning gang is located at one end and the volume control at the other. To make sure the tuning gang will fit into place it is desirable to mention that it was a midget MSP two-gang, although almost any small gang could probably be pressed into service. It is mounted low down on the chassis, and a small cut-out prevents the moving plates from fouling when completely out of mesh.

There is plenty of room for all the coils, filter condensers, choke, power transformer and valves on the chassis. The only point to watch is

REAR VIEW OF SET IN CABINET



This picture shows the chassis neatly mounted at the bottom of the cabinet. It is held in place by two long ⅛ inch bolts which run through both chassis and the bottom of the cabinet.

the electrolytic condensers—these should be of the midget type or they might foul the frame of the loudspeaker. Otherwise you should have no trouble in fixing everything in place. Unlike some small set layouts, there are no special brackets or awkwardly crowded wiring spots to worry about.

There are several small power transformers which should fit the chassis, but it might be a sensible precaution to stand everything in place before wiring up to make sure your components fit as easily as ours did.

GANG MOUNTING

The gang is mounted toward the rear of the chassis so that an extension shaft can be fitted. This is necessary because the knobs are made for a standard ¼-inch shaft, and the capacitor will probably have a 3-8 inch shaft. As you will see from the photograph there is no trouble with the extension piece, and it won't normally be necessary to cut anything from the condenser shaft as supplied.

The aerial coil is mounted away from the others mainly to isolate the input circuit from the IF channel. Some of the coil kits these days have extremely high performance, and any coupling between the aerial and the IF channel can cause oscillation unless the aerial lead is kept well away from the rest of the set. This is virtually a standard precaution these days.

The wiring diagram shows how we mounted the parts, most of which can be soldered by their pigtails directly to the circuit points concerned. The use of a few tag strips takes care of the remainder, the object being to see that every connection is firmly made, and nothing is left flopping about.

Mostly the parts are of the miniature type now freely available, and there is little point in using larger components, even though there might be room for them. The smaller sizes help very considerably to keep the wiring neat, and when you have finished your job should look quite professional.

Note that the first filter condenser has its can insulated from the chassis, as back-bias is used. Make sure the terminal points connecting to the can clear the chassis by an adequate distance. A touch with a small file is all that is needed to make sure of this point if by some chance the mounting holes are not accurately punched or drilled.

HUM LEVEL

The second filter condenser may be bolted directly to the chassis in the normal manner, and should make good contact with it. Some earthed points are made by means of solder lugs under convenient nuts, which mount the valve sockets or coil cans. Others can be earthed to the earthed lugs on the tag strips.

If you wish to make quite sure of earth points, they can all be connected together with some tinned copper wire.

Homecrafts PTY. LTD.

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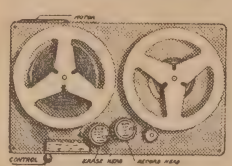

★ Weight 7½lbs.
★ High fidelity 50 to 9000 c.p.s.
★ One hour playing for each spool.
★ Self-contained motor.
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Plus 12½% Sales Tax.

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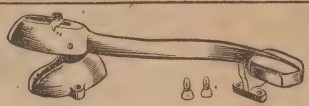
MAIL ORDER to Box 514J, G.P.O., MELB.



PICK-UPS

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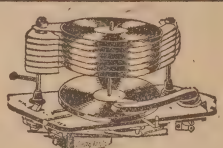

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Valves:—

Type 7A6. All brand new . .	7/11
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Resistors:—5 watt. Wire Wound. 350 ohms, 500 ohms, 1500 ohms . . . . . **1/- each**

English Loctal Sockets. Cut to, each **3d**

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Standard Speaker Transformers, 200 ohm to 2.3 Voice Coil. Each **1/-**

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30 Henry 100 mA. Chokes, only **12/11**

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FINE QUALITY METERS—English Moving Coil, 2in. Scale—200 ohms per Volt:—

0-20 Volt	14/11
0-3 RF Amp.	4/11
30-0-30 Amp.	35/-

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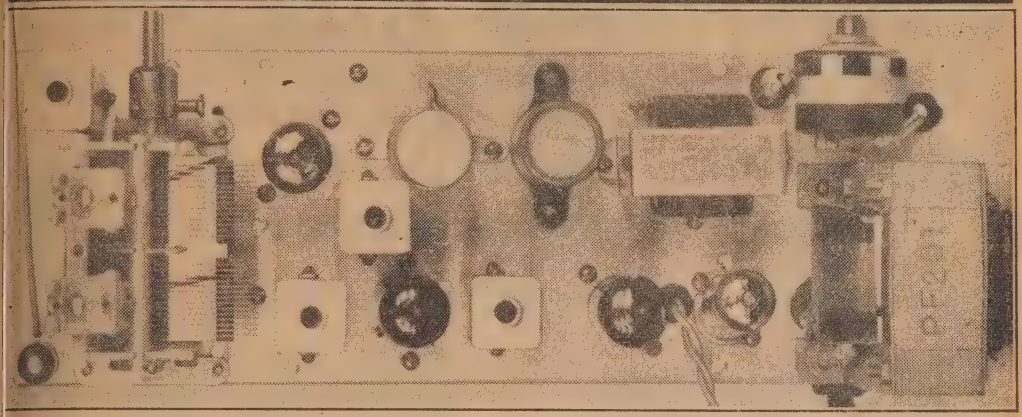
290 LONSDALE STREET, MELBOURNE. FB3711

PLAN SHOWS HOW COMPONENTS ARE MOUNTED



This plan view shows that the components are not crowded, and that mounting is a very simple matter.

A little residual hum is generally not important with a small set, but because this one uses a larger speaker than most, you may wish to remove it altogether. In this case, a 25 mfds midget electrolytic as used to bypass bias resistors can be connected across the back-bias resistor of 100 ohms, with the positive end (usually colored red) connected to the chassis. The use of the back-bias resistor cuts down the number of components and allows the cathodes of the valves to be directly earthed, which has some advantages.

VOLTAGE RATING

Because the high tension is only about 200 volts, the capacitors involved have an easy life, and need not carry a high rating. However, most of them will carry a rating not lower than 300 volts which gives a useful safety margin.

The power transformer as is the case with most small types, may run rather warm after a few hours use, but this need not cause you any concern. It is rated at 50 mills, and the total drain is not likely to exceed about 45 mills. There is adequate ventilation because of the cabinet design, and this is another advantage not possessed by all small sets.

Unfortunately, coil makers do not adopt a standard method of mounting for midget coils, so that we have been obliged to prepare our chassis blueprint for one of the several brands available. Ours were again from the Aegis factory, but any equivalent set of coils can be used having a similar can cross section. The only difference is that you may have to pay a little more attention to their mounting on the chassis, but we can't be blamed for that!

No significant changes will be required to the wiring diagram, and coil makers invariably mark their connections quite clearly. The dial markings are largely dependent on the gang type, and will probably work out quite well for other types of coils.

The padder required for the coils used is 450 pf with a 2½ pc rating, and we suggest this value to give full dial coverage. Lining up will be made easier if the trimmers have a 70 pf maximum capacitance, rather than 30 pf characteristic of some makes. Suitable trimmers, such as Cyldon, are readily available.

Lining up the set is a standard procedure. With the gang substantially in mesh, tune in a station, preferably the one marked at this end of the dial, and adjust the slug of the oscillator coil until it is received at its correct spot. Next, bring the aerial slug into line so that the volume is greatest.

Now tune to the station at the other extreme of the dial movement, so that the plates this time are substantially out of mesh. Adjust the oscillator trimmer, not the slug, until this station corresponds with its marking, and adjust the aerial trimmer for the loudest signal.

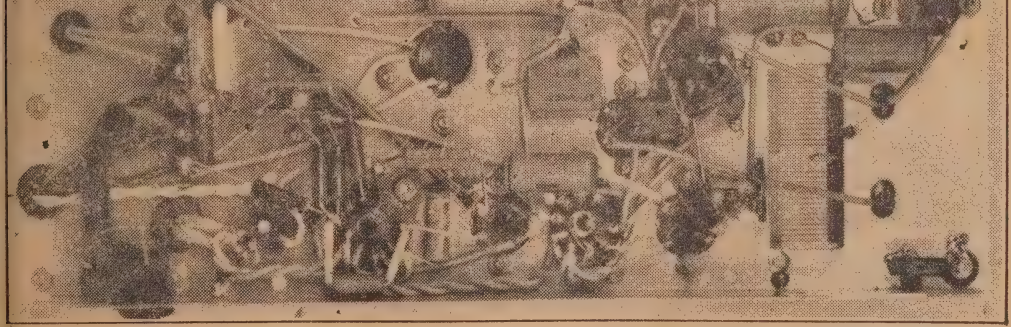
Go back over these adjustments once or twice, until you have the stations on their correct settings at each end of the dial.

The rule is to adjust only the slugs at the low frequency end of the dial, and only the trimmers at the high frequency end.

ALIGNMENT

The IF transformers will have been aligned to 455 Kc at the factory, but after the gang settings have been established, but not before, it is in order to adjust them for loudest signals.

Choose a weak but clearly heard station for this adjustment, and you



An actual under-chassis picture which may be compared with the wiring diagram.

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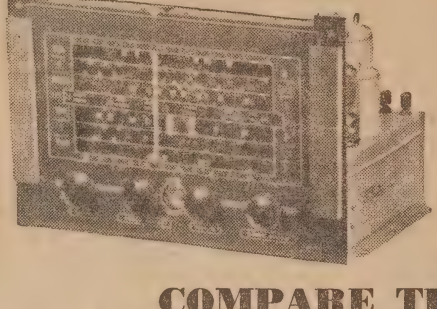

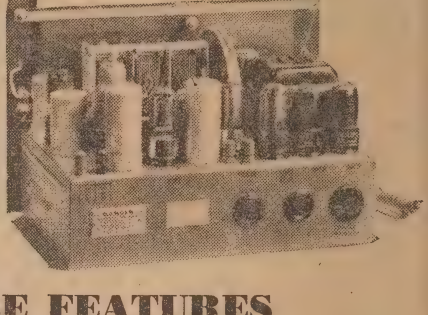

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- High gain audio with push-pull output and tone control gives you high fidelity reproduction from both radio and your favorite recordings. Inverse feedback incorporated.
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- Tuning is made simple and positive even on oversea stations by the use of a super sensitive magic eye tuning indicator.
- All chasses are wired for the fitting of an F.M. or Tape Recorder. Special plug on back of chassis being provided, also standard 3-pin socket for power supply to motor.
- Speakers supplied are Magnavox 12in and 8in permanent magnet with tropic proof transformer.
- Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations in each State in prominent type, fitted with counterweight drive and indicator lights on dial showing which band in operation.
- Dial can be supplied in cream or brown with matching knobs and escutcheon to suit blond or walnut cabinets.

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CLASSIC RADIO

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should find that only a small movement of the IF slugs is needed to bring the set "on the nose". Make a note of the original setting of the slugs so that you can come back to them if you strike trouble. If you have a good service oscillator, your job will be made so much easier, but it is not essential.

If you should find the set showing weak oscillation on faint stations when lined up, first make sure that the aerial lead is not running near the IF section of the set. The length of the aerial is sometimes important, and it should not be less than about 20ft of wire—ordinary plastic covered hook-up wire is good.

STABILITY

Should oscillation still persist, a 50,000 ohms resistor wired from the aerial terminal to the chassis should cure it, without materially affecting performance. As we have said, modern coils have a very high gain, and odd cases may be found where they will spill over on weak signals.

Persistent cases often succumb to a .1 meg or 50,000 ohms resistor across one of the IF windings, but this should rarely be necessary.

The cabinet will take any of the popular makes of 8in speakers. To make sure of this point, we mounted both a Rola and an MSP speaker and tested them with the set in position. The cabinet has holes ready tapped for 3-16th x ¼ inch bolts.

The output transformer is mounted on the speaker and this is normal practice with such speakers. It is a good idea to earth the frame to chassis, and one side of the voice coil to the frame. The .005 condenser across the speaker input can be mounted either on a tag strip on the speaker frame or in the set itself.

When the set was finally lined up—without any need to suppress oscillation by the way—and using a 20ft aerial as specified, we tried it out against a well-known commercial mantel set of recognised performance. Our set showed better sensitivity and much better tone, indictating that it is in no way inferior to the factory made article.

A signal generator test supported the aural test. At 600 Kc our set showed 26 mV as against 69, at 1 Kc 26 mV as against 85, and at 1500 Kc 36 mV as against 45.

On the air reception was by no means limited to local stations. At night time it was difficult to find any setting of the dial which was clear of a signal.

BOOK REVIEW

THE OSCILLOSCOPE, by George Zwick. Published by Gernsback Publications, Inc., Gernsback Library No. 52. 192 pages, stiff paper cover.

In presenting this book, the author's stated intention has been to produce an instruction manual, which will allow an oscilloscope to be used intelligently by someone who has not hitherto had much to do with the instrument.

To this end, the first three chapters are basic and fairly elementary, covering waveforms of various types, the structure and function of cathode-ray tubes and the operation of sweep circuits. Chapter 4 is largely an examination of typical oscilloscopes and their circuitry.

Chapter 5 describes the oscilloscope as an aid to alignment, particularly in relation to FM and television receivers. It is a big jump from the previous "How it works" theme but it is material which will shortly concern local technicians.

The remaining chapters in the book describe how the oscilloscope is applied to various other tasks, such as testing amplifiers, checking tuners, power supplies and so on. In so doing, the author describes various incidental measuring techniques, mentions effects to watch for and shows typical patterns to be expected.

The book concludes with a chapter on experiments for those who want to learn by doing.

THE OSCILLOSCOPE AT WORK, by A. Haas and R. W. Hallows. Published for Wireless World by Iliffe and Sons, London. Hard cover, 171 pages.

Written originally in French by Haas, the book has been adapted and translated by R. W. Hallows. It is intended for fairly advanced students and laboratory workers, as evidenced by the fact that only the first chapter is devoted to fundamentals. For the most part, the remaining 10 chapters describe the use of oscilloscopes to test various equipment and circuitry.

Chapter 2 deals with the investigation of electrical magnitudes which, in addition to the usual DC tests, describes the measurement of capacitance, inductance and reactance, the study of hysteresis loops, the use of circular time bases and many other lesser known techniques.

Following chapters describe tests on audio amplifiers, RF amplifiers, oscillators, rectifiers, detectors, modulators and a variety of wave-shaping circuits.

There is a special section on testing television receivers, a trouble-shooting chapter relating to oscilloscopes and a series of improvements aimed at extending the uses of existing instruments. The text is freely illustrated throughout with diagrams and oscillograms.

(Continued on Page 105)

Here's your answer, Tom!

Radio and Hobbies does not normally answer questions of a zoological nature. However in a recent letter from Tom we have discovered a question which warranted detailed explanation, although at first glance it seemed to deal with a well known Australian bush animal.

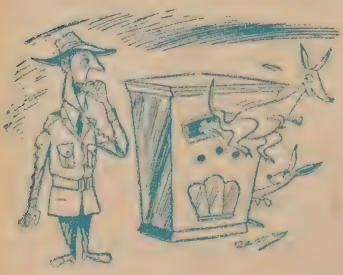
PERHAPS Tom is being a trifle facetious, but what's it matter. He seems to have a real problem on his hands. It appears that he had been reading one of the Serviceman's articles in which reference was made to "joeys". We quote from his letter:

I know that he has found many unusual things in receivers in his day, such as cockroaches and dead mice, but it is beyond my comprehension, how baby 'roos can get inside a radio set. As my dictionary does not list the word, I had to ask one of my friends about the meaning of "joey", and baby kangaroo was the only explanation I could get.

Australian radio slang is certainly colorful, Tom, or it is in this case. But you were right in one part of your question. Under cross-examination our Serviceman confessed that he has yet to find a baby 'roo in a radio set. "But," he added, arching his brows, "I have found many a joey. Pretty lively ones at that."

You see, Tom, there are three distinct species of "joeys". One, of course, is the undeveloped young of the kangaroo, which is carried about in its mother's pouch.

Then, there is the cockatoo or parrot, kept as a pet. As you know, Tom, these birds are quite capable



A "Joey" in the set . . .

of imitating human speech or whistling. Sometimes they can even produce a creditable "wolf whistle". And, more often than not, you will find that they are called "Joe" or affectionately "Joey".

It appears most likely that this latter kind has given its name to a third kind of "Joey". We refer to the whistling gremlin that haunts radio designers and servicemen in their daydreams and nightmares. It usually shows up when you tune across the dial of your receiver and is at times referred to as "joeys". It is called a lot of other names as well!

As a matter of fact it appears that the gremlin has singled out Tom's very own portable, built with so much care, as its next victim. Judging by the rest of his letter he has had more than his share of whistles and joeys.

How do you suggest that I eliminate these (the whistles) and what are they due to, anyway? I assume that the double hump may be due to an IF transformer winding being off resonance. I have aligned the IF's as accurately as I can on station 2YA (570 Kc). Do you think I should align the IF's in another portion of the band to eliminate this defect?

All right, Tom, first the whistles. The main cause of these is unwanted signals on the grid of the converter valve. These will be signals which have been able to force their way through the tuned stages ahead of the converter and appear on the signal grid in sufficient strength to cause trouble.

Ideally, of course, this shouldn't happen, because we provide an aerial tuned circuit, and, in larger sets, an RF tuned circuit as well, for the express purpose of filtering out these unwanted signals. Unfortunately, in practice, there are several reasons why this doesn't always work out.

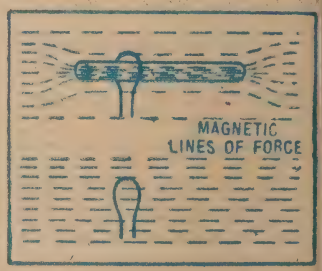
COIL EFFICIENCY

For one thing, the efficiency of the tuned circuits may be poor and the importance of maximum efficiency in this part of the circuit is something which the beginner is inclined to overlook. Normally, modern coils employ all the well established techniques, such as the use of iron dust cores, Litz wire, &c., which produce high efficiencies. But the benefit of all these will be lost if the circuits do not track correctly, both with each other and the local oscillator circuit.

Too large an aerial, in the vicinity of a powerful transmitter, can make matters worse by delivering such powerful signals to the set that a substantial amount reaches the converter grid in spite of all the tuned circuits ahead of it.

Once an unwanted signal reaches the converter, there are all manner of possible combinations which can occur, which will produce whistles. The converter itself is essentially a non-linear device (it has to be to do its job), and so will distort all the signals it handles. As a result, we ca have harmonics of the incoming si nals, both wanted and unwant harmonics of the local oscillator, a harmonics of the intermediate fr quency.

You can go crazy, Tom, trying work out all the possible combin tions, but you can take our word for that there are many which will cor bine to produce the intermediate fr quency or a harmonic of it. Actuall the worst condition is one whe the resultant is not exactly equal the IF or its harmonics, but diffe



How the loopstick works.

from it by an audible amount, th difference producing the note whic you hear as a whistle.

An incorrect IF can aggravate thi condition, since it is quite possibl that the second harmonic of the I will be within a few thousand cycle of one of the local station frequen cies. It is for this reason that a stand ard IF of 455 Kc has been adopte by most manufacturers, the frequen cies of the broadcast stations havin been allocated on the basis of this IF (At least, this is the case in Aus tralia.)

MATTER OF CHANCE

It would be impossible to say wha frequency your IF channel is adjuste to at the moment, Tom, this bein largely a matter of chance and be ing little affected by the station yo selected for your adjustments. Mos IF's, as received from the manufac turer, should be set fairly close t the correct frequency and should onl need a "touch up" of a turn or so t bring them into correct alignment.

In any case, it is likely that you IF channel has been set to the fre quency to which it was most nearly tuned before adjustment. This is as suming that it was only touched up

d not moved far from the original tting. Otherwise, the frequency uld be almost anything and other mplications could also arise.

This brings us to the second part your question, Tom, regarding the uble hump effect and whether it ght be eliminated by adjusting the with a signal in another part of the nd.

Whatever the cause of your double mp, Tom, we doubt whether using other broadcast station as a source signal will help. To appreciate this int, it is necessary to realise that incoming signals, no matter what eir frequency, will be changed to e intermediate frequency. Thus, as r as the IF channel is concerned, e signal looks just like another and ill be treated in exactly the same anner.

FALSE PEAK?

It seems far more likely that you ve either adjusted one of the windgs off resonance, or that you have lected the "false peak" in one or ore windings. The false peak is due setting the slug too far in, and here it can provide unwanted coupg with the other slug. This can mpletely ruin the characteristics of e transformer and produce the ef-t you describe.

Iron cores should always be set the peak, which occurs with them far out of the winding as possible. The best advice we can offer beginners who get themselves into ife of this nature is to make every fort to get the IF channel correctly igned. Once this is working corctly, the remainder of the adjustents can be made with reasonable curacy, using the broadcast staons.

In his final question, Tom brings the subject of ferrite rod aerials. e asks:

I noticed that the latest portable cuits in R. and H. specify a rod rial or "loopstick". Are they any tter than conventional loop aerials? ow do they work, anyway?

Well, if they didn't give as good better results than a loop aerial, m, we would not specify them in r circuits.

Generally rod aerials or loopsticks e used in small portabel sets, here it is not possible to use a op sufficiently large to give good ficiency.

To understand their operation we ve to have a look at the source the signals and the transmitting rial. You see, Tom, these aerials t up two kinds of fields around em. Outside straight wire aerials spond to the electric field, loop erials generally to the magnetic ld.

NES OF FORCE

Now you probably know, Tom, at, if the lines of force from an ternating magnetic field pass rough a coil, they will induce a rrent in that coil. Furthermore, e more lines of force passing rough the coil (i.e. the stronger e magnetic field is) the stronger ill the induced current be.

Supposing we have a magnetic field ith one line of force to every square ch. It immediately becomes obous that the larger the area of r loop, the stronger the current duced in it will be. There will e more lines of force passing through it. But there is a practical limit to the size of a loop—it cannot be any larger than the receiver cabinet.

So some bright fellow reasoned this way: If we cannot increase the area of the loop, why couldn't we increase the number of lines for a given area? He was thinking of the well-known principle that magnetic fields pass through certain materials more easily than through air. They actually attract magnetic lines of force.

NOW PRACTICAL

However, only after the introduction of electrically insulating magnetic materials could this idea be put into useful practice.

The reason for this is that a magnetic field induces currents not only in the coil or loop surrounding such magnetic material, but also in the material itself if it happens to be a conductor. These currents are well known as "eddy currents", and losses due to them can be very high at radio frequencies.

Modern ferrites, containing oxides of iron and several other metals, have very good magnetic properties (high permeability), and, at the same time, are very good insulators. As a result, their eddy current losses are very low.

A ¼in diameter loop with a ferrite core of about 6in length will collect about the same number of lines of force as a 10in diameter loop without a core. This means that it will have about the same efficiencies but will be much smaller physically.

It will also have the advantage of having a much higher Q, making the receiver more selective and at the same time suppressing unwanted signals and "joeys".

In receivers where size and weight are important considerations, the rod aerial or loopstick definitely gives better results than a small loop.

Why do new radios lose their volume on short wave after about 12 months' use?

We don't agree, Tom, that this will necessarily happen in all cases. Where it does, however, there could be a number of reasons for it. Firstly, there are the effects of dust and moisture. Both are age-old enemies of electrical equipment. Dust accumulates between switch contacts, connecting wires and gang plates, absorbing moisture from the air.

This layer of dust is electrically conductive, presenting a partial short circuit for radio frequency currents and sidetracking them.

Now signals on the short wave are usually much weaker than on broadcast and losses in the receiver become noticeable on the short wave-band first.

For this reason, the highest quality equipment is usually dust and moisture proofed. And as moisture also attacks bakelite insulation, non-hygroscopic ceramic materials are used in particularly sensitive parts of such equipment.

Another possible reason would be the shifting of coil slugs and trimmers due to ageing and mechanical vibrations. This used to be quite a common problem a few years ago. Present day components are much less subject to such deterioration.

real genius in their choice of name "Ultra-Linear". Applied the commercial field, such ge would lift an obscure radio or frigerator to the top of the mar As a name it's a real "beaut". amplifier can be expected to these days, unless it contains modern wonder.

Unfortunately, the name is palpably extravagant and meani less that I doubt it will ever t its place in technical literature al with traditional terms. On a p manent basis I mean. I can't learned writers and engineers ad ing a term which describes a linea curve as being straighter t straight!

WANTED: A NAME

Consequently all and sundry busily engaged, just now, in popular pastime "Give It A Nam It isn't easy, either.

One English correspondent ref in most dignified fashion, to "t tributed load pentodes". As a te it's technically correct but rathe hazard for those who wear fa teeth! It has the same mellifl quality as Horatius Augustus Ra bottom!

One might suggest, of course, combination of words to prod something like "tripode" or "tritod

Let's Buy An Argument

After having spent so long with traditional amplifiers of the triode and pentode variety, it is a refreshing change to have something new to think about. I refer, of course, to the "Ultra-Linear" circuit and all the problems which it poses.

BUT perhaps I should begin by qualifying the words "something new", because they are not strictly true!

About three years ago (February, 1952, to be precise) we reprinted an article on the subject which had appeared just previously in the American magazine "Audio Engineering". It was written by two worthy gentlemen, Messrs. Hafler and Keroes, who proclaimed the virtues of the circuit in no uncertain fashion.

PRIOR TO THAT . . .

Previous to that, however, in 1943, an English author had something to say on the subject and he is currently lamenting that the idea had to go to the US and back again before it received any real attention from English designers.

But it seems that the idea had already travelled a fair distance before that—all the way, in fact, from Australia! As far as I can gather, it was first conceived and put into print by Messrs. Rex Lackey and Bob Chilton, of the Australian Radio College. The date? Somewhere about 1932!

As the story goes, they had just received one of the wonderful new pentodes (or maybe penthodes) and, while impressed by its output and sensitivity, were anything but impressed by its "tone". Perhaps some kind of a compromise could be struck?

Suiting the thought to the deed, they picked out a push-pull output transformer, connected one side to plate, one side to B-plus and ran the screen to the centre top. This half-triode, half-pentode thing sounded so promising that students of the said college were officially advised to use their pentodes that way!

If one might repeat a well-worn phrase—"There is nothing new under the sun".

Apart from a well-phrased article, Messrs Hafler and Keroes showed

by **Neville Williams**

(Please accept my humble apolog The best term I've heard to d is "partial triode", suggested by M Langford-Smith. It's simple, factu and easy enough to say.

But enough of that. Let's get with more technical business.

As you will doubtless appreci by now, "Ultra-Linear" poses so tricky problems, partly by its natu and partly because it happens come at a time when the whole co ception of amplifier design is chan ing. Engineers are striving to evol new criteria by which performan can be judged.

ROOM FOR RESEARCH

While the Ultra-Linear circuit ce tainly works very well in practice, theoretical background is full of ga —like some of Sydney's "shar proof" nets. It may be 12 mont or more before the full pattern its operation begins to emerge.

Just how, for example, should t Ultra-Linear circuit be regarded? there something specially benefic or mysterious about tapping t screen down the load or is it bas ally just a convenient method applying feedback around the ou

stage? It's rather important to this matter straight.

The idea of a feedback loop around output stage is gaining favor yway, these days. Such a loop is the position where it can do most od and where, being confined to e stage, there is the least risk it producing instability due to ase rotation. An additional loop loops), may still be used over veral stages but they can afford operate with more modest degrees gain reduction.

PUT IMPEDANCE

Care is necessary, however, be-ase the traditional feedback cir-it from plate to grid of an output ge severely lowers its input im-dance and makes things difficult the proceeding valve.

The Ultra-Linear arrangement ercomes this problem very neatly or so it would seem. The grid ut impedance does not appear to drastically affected and the two tive elements (plate and screen) e as intimately coupled as one uld wish for. What is more, an erall feedback loop can embrace e stage as simply as it would a aight triode or pentode. All that on the credit side.

However, this "feedback", as we have called it, tends in some cases to degrade power output —and that is something that feedback doesn't normally do!

Is this because we are applying e feedback to an element (the reen) which is often not too linear its control characteristics? Some ave suggested that, when the screen verloads"—or runs into its non-near region—the output of the age goes awry.

Personally I doubt this line of asoning, though it may contain a odicum of truth. I am more in-ined to look for the solution of e power output problem in the ndamental difference between a iode and a pentode.

The pentode (or tetrode) gets its extra power and efficiency in no small measure from the ability of the screen to keep current flowing through the valve when the plate voltage swings to quite low values. It extends the load line into a region which a triode can only match by running the grid positive, as in class B.

RIODE v. TETRODE

To see what I mean, have a look t figure 1, which compares the haracteristics of a 6V6 operating lternatively as a tetrode and a riode.

Under ordinary tetrode conditions, vith 250 volts on plate and screen nd a bias of -12.5, the maximum ignal grid swing is from zero to 25. These two bias lines are rawn solid, together with the rele-ant 5000-ohm load-line.

Note how the plate swing ex-ends from over 400 volts down to ess than 50, while the current wings on peaks from over 85 down o around 10 milliamps. Reduced o RMS values and multiplied out, he figures yield a power output ating of 4.5 watts.

For triode operation, the screen is onnected to plate so that the screen

CURVES HAVE A STORY TO TELL

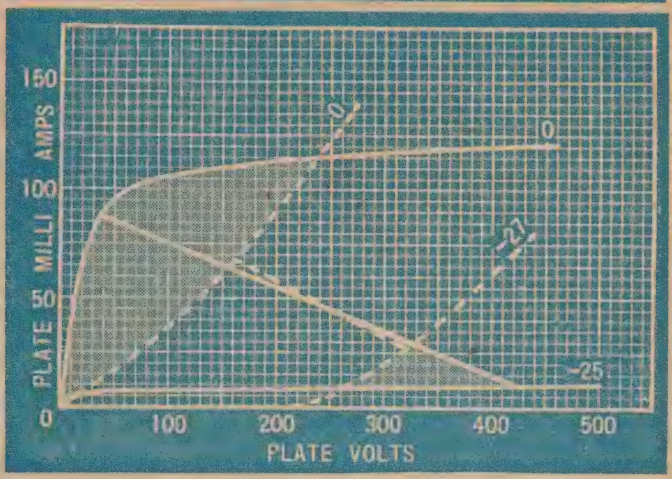


Figure 1: A comparison between the plate swing of a 6V6 as a pentode (solid lines) and as a triode (dotted). The shaded area represents the advantage the pentode has in power output. But what would the Ultra-Linear curves look like?

voltage must follow the plate voltage exactly. When the plate voltage swings downward, the screen voltage naturally follows suit.

The effect on characteristics is drastic as far as power output is concerned. Have a look at the triode curves, shown dotted and note how the peak voltage and peak current swings are reduced to about half those for the original tetrode connection. The whole of the shaded portion of the graph is virtually lost and power output reduced by over 4:1.

"IN BETWEEN" CHARACTERISTICS

In the ultra-linear arrangement, since the screen is tapped part way down the load, it seems logical to assume that characteristics will fall somewhere between the limits shown in figure 1. Peak plate excursions will not be as great as for the pentode connection, with a consequent loss of output power.

But why is the effect apparently more noticeable with some valves than with others. Some suffer a reduction of nearly 40 pc below

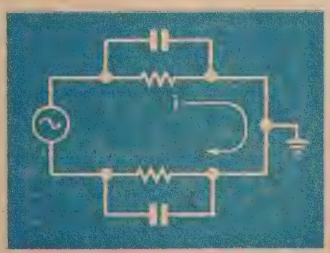


Figure 2: If the phase splitter can be represented as a generator in a series circuit, it must be self-balancing.

the pentode output power. Others, notably high transconductance types, suffer hardly any reduction at all!

It might be suggested that the plate current in such types is more sensitive to variations in grid voltage than in screen voltage.

Yet again, it may be the result of some "accidental" screen characteristic of a high-Gm tube. Something to do, perhaps, with grid-screen or screen-plate transconductance. Such figures are not normally extracted or published.

It might even be that the performance of an Ultra-Linear stage could be predicted from the kind of comparison envisaged in figure 1.

It would be an interesting field for investigation, if one didn't have to do other things in life than write these columns.

Some English designers have shown preference for an arrangement which often shares the name "ultra-linear" or "distributed load". I'm not trying to impugn the designers here, as much as to draw attention to a vague idea that seems to be abroad that the Ultra-Linear scheme can be achieved alternatively in the cathode circuit.

SCREEN SUPPLY

In this arrangement, the screens are returned to their normal B-plus feed point, which is a handy feature if the optimum screen voltage has to be less than the plate voltage. It saves the untidy business of having to string dropping resistors and bypass capacitors between each individual screen and its tapping point.

The difference is in the cathode circuit. Instead of returning to earth directly, the cathode returns pass through an additional winding on the output transformer.

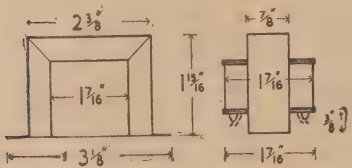
The voltage injected into the cathode circuit thus appears as a potential difference between cathode and

R.C.S. release details of . . . CHOKES . . . TRANSFORMERS

Here are full details of types available in R.C.S. filter chokes, audio chokes and transformers, filament and auto transformers, speaker transformers and speaker replacement windings. It is suggested that these details be kept for reference. These R.C.S. components are both designed and manufactured in the light of latest findings in the field of electronics. Brackets are of aluminium and bobbins are of moulded polystyrene.

FILTER CHOKES AND SPEAKER TRANSFORMERS

Size: Core Section ⅜in x ⅜in 10 watts
o/all sizes 2⅜in L x 2in H x 1⅛in W.



FILTER CHOKES

	Retail Price
TC 66 14/60	10/6
TC 66 Windings only	6/6

SPEAKER TRANSFORMERS

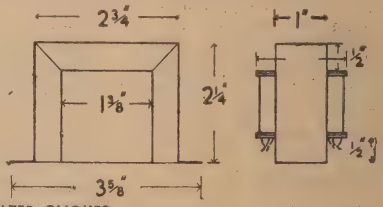
Type	Primary Ohm	Voice Coil Ohm	
TS 23 Single Triode	3500	2.3	16/-
TS 24 Single Triode	3500	3.9	16/-
TS 25 P/P Triode	3500	2.3	16/-
TS 26 P/P Triode	3500	3.9	16/-
TS 27 Single Pentode	5000	2.3	16/-
TS 28 Single Pentode	5000	3.9	16/-
TS 29 P/P Pentode	5000	2.3	16/-
TS 30 P/P Pentode	5000	3.9	16/-

SPEAKER REPLACEMENT WINDINGS

F 132 Single Triode	3500	2.3	7/-
F 133 Single Triode	3500	3.9	7/-
F 134 P/P Triode	3500	2.3	7/-
F 135 P/P Triode	3500	3.9	7/-
F 136 Single Pentode	5000	2.3	7/-
F 137 Single Pentode	5000	3.9	7/-
F 138 P/P Pentode	5000	2.3	7/-
F 139 P/P Pentode	5000	3.9	7/-

CHOKES AND TRANSFORMERS

Size: Core Section 7/8in x 7/8in 15 watts
o/all sizes 2¾in L x 2in H x 1⅜in W.



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rid, and between cathode and creen.

Naturally enough, the feedback ignal between cathode and grid as by far the greater influence on he valve's performance and, in act, it becomes a half-baked cath-de-loaded output stage. It recalls he work we did with these circuits dozen years ago and the discus-ions as to whether the screen should ie connected to B-plus, or decoupled nd by-passed to cathode.

Without getting involved again in ll the details, I can't see that the athode feedback arrangement has uch in common with the original Ultra-Linear" or tapped screen ircuit.

A BETTER CIRCUIT?

It operates primarily as plate-to-rid feedback, the screen feedback aving only a very secondary effect. his being so, it should not show a arked degradation of power with ny output valves. It may, in fact, e a better circuit on this count, hough demanding a more compli-ated output transformer.

We shall see.

Returning now to the "Ultra-inear" (or partial triode or screen eedback) arrangement, the editor nade a few tentative remarks last nonth about the possible complex oading effects such a stage may nave on the driver valve.

They were prompted by a higher-han-anticipated IM distortion read-ng when using a conventional plate-athode phase splitter. Though there was no time to track it right down, t appeared to have some connection with the overall balance of the push-pull output system (note that I said "appeared to have").

At this stage, I can well imagine a particular section of audio enthusi-asts leering in a most objectionable fashion and mouthing the words, "I told you so". However, such an attitude is scarcely justified.

All arguments we've ever had on the subject have been based on ob-servations within or just above the audible spectrum and using conven-tional triode and pentode circuits. When tracked down, every con-demnation of the phase splitter, thus far, has turned out to be due to error introduced by meter or CRO input impedance and its unequal loading effects on the two sections of the circuit.

INPUT IMPEDANCE

When we came up against the problem on this occasion, the natural reaction was to speculate about the input impedance to an Ultra-Linear stage. Was there anything unusual about it?

There seemed to be no reason why the input resistance should change but what of input capaci'ance? "Mil-ler effect", for example?

When you come to think about it, imposing a signal voltage on the screen approximately equal to one half the instantaneous plate voltage, must re-introduce Miller effect as a significant quantity.

While the Miller effect formula is simplicity itself in its usual form, the Ultra-Linear circuit introduces some special complications. We could reduce the gain figure (m) by an appropriate amount but what of the grid-screen capacitance? It was not available for any of the valves with which we were concerned.

My guess was that the input capa-citance to a typical Ultra-Linear stage would be 100 pf or more, de-pending on the construction of the valve and its transconductance. This value of capacitance would be shunted across each half of the phase splitter output.

But why the sudden interest? What of straight triodes? Wouldn't Miller effect be a lot worse than with Ultra-Linear?

Not necessarily. If you consider the popular 2A3, it has a stage gain of 3 and a grid-plate capacitance of 16.5 pf. This gives us a figure for input capacitance, all told, of no more than 70 pf.

My tip is that an Ultra-Linear

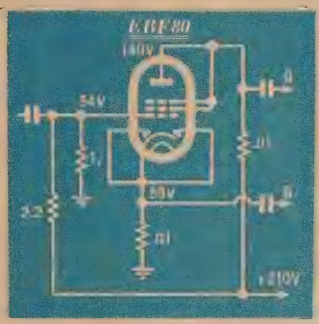

Fig. 3. From the magazine "TSF et TV" comes this rather unusual version of the phase-splitter. Whether it has any advantage to offer is doubtful.

stage, using a high gain valve, could double that figure.

Having thus "guesstimated" a figure of such proportions, one might be excused for assuming that the capacitive shunting would unbalance the phase-splitter at high frequencies, since it would presumably shunt the high impedance plate side more seri-ously than the low impedance cathode side. However, such is not the case.

SERIES CIRCUIT?

Reduced to fundamentals, the phase-splitter may be regarded as a generator with a load in each leg returning to a common "earthy" point. Each load is made up prin-cipally of a DC load resistor (usually about .05 meg), shunted by a fol-lowing grid resistor (usually 0.5 meg.) and a virtual capacitor, as al-ready discussed.

It is, in fact, a simple series circuit and, provided the two loads remain symmetrical, the circulating current around the series circuit must develop iden-tical signal voltages across them.

Ordinary care in wiring should preserve the capacitive balance well enough while the resistors can be checked, one against the other, with nothing more elaborate than an ordinary ohmmeter. This is one of the big features of a phase splitter.

The difficulty arises when we try to attach any measuring equipment at all to the circuit to check what commonsense tells us must be cor-rect.

In the supersonic region, the capa-citance of a test lead, hung on the cathode side, can be quite sufficient to act as a partial bypass and in-crease output on the plate side. Con-versely, such extra capacitance on the high impedance plate circuit markedly reduces the output, lead-ing to an entirely false impression.

Just how important this point is became apparent from some further observations on phase splitter oper-ation.

Examination of the behavior of a phase splitter in a typical Ultra-Linear amplifier showed the balance to be virtually perfect at 1000 cps and still perfect at 10 Kc—or so close that it didn't matter. But at 50 Kc the balance had deteriorated markedly.

Then I noticed that touching the VTVM lead on the respective grids had a slight reaction on the output of the amplifier, as shown on a separate meter. Touching the VTVM lead in he cathode side increased the output slightly, while touching it on the plate side had the opposite effect.

AFFECTING CIRCUIT

Very obviously, a perfectly re-spectable Vacuum-Tube Voltmeter was affecting the circuit, despite its apparently high input impedance.

Substitution of an RF probe for the normal audio test lead practic-ally eliminated the effect and re-vealed that the balance was indeed very close to perfect.

If the phase splitter is indeed un-satisfactory with an Ultra-Linear stage, we will presumably have to invent another explanation for it. It is entirely possible that our queries were due to some other effect which escaped our notice.

The evidence was purely circum-stantial.

Just in passing, I noticed re-cently in a French radio magazine, an interesting variation of the tra-ditional phase-splitter circuit.

In an effort to reduce the over-all impedance of the stage, the plate and cathode loads had been reduc-ed to 10,000 ohms each.

In addition, instead of returning the grid resistor to a point on the cathode circuit, as is usual, the grid taps into a high impedance divider strung between B-plus and earth. The resistors are so proportioned that the grid assumes a potential slight-ly and suitably less positive than the cathode.

WHAT ADVANTAGES?

On the surface, the arrangement would not appear to have any special advantages. The assumption of correct operating conditions would not be quite as automatic as with the conventional arrangement and the stage would have a much lower input impedance.

The flow of signal current through the grid circuit would certainly be more or less direct to earth in-stead of via the cathode load, but this has never been considered as a significant factor in the practical operation of a phase-splitting stage.

However, there's the circuit, for what it's worth, in figure 3.

There is one difficulty about the phase splitter which is well known I refer to its poor overload charac-teristic on the plate side.

The moment the particular output

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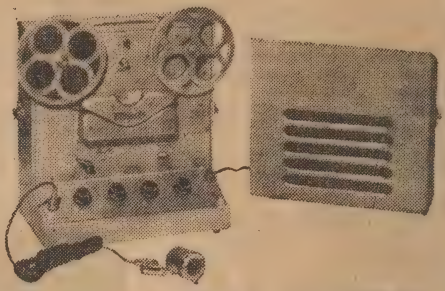

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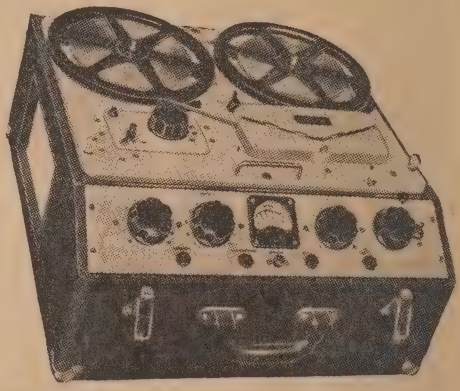

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alve runs into grid current, the rave pattern flattens abruptly. While a good amplifier system should ever have to be pushed anywhere ear this extreme, the effect doesn't ook nice on a CRO screen and a nore gradual overload characteris- ic is to be preferred.

Various phase inversion circuits ave been evolved which present lower and reasonably balanced ource impedance for the push-pull ignals. Unfortunately, however, hey lack the big feature of the phase plitter in not being self-balancing n terms of grid drive.

Some achieve an automatic and ermanent degree of unbalance. Others achieve balance by a care- ul selection of circuit values. But hey go out of balance if the valve ections should age differently in ervice.

Some use too many coupling com- ponents, leading to a "messy" cir- uit and a suspected source of phase otation. Others are too easily pset by a flow of grid current in he output stage.

A NEW CIRCUIT?

Just before penning these senti- nents, I succumbed to the urge to nvent a phase inverter circuit all o myself that would be less prone o these difficulties. Well, I did in- ent one that's original as far as 'm concerned. It may or may not e so to readers.

Have a look at it, anyway, in igure 3.

It starts off with one section of a twin triode as a traditional phase splitter. The drive for the lower output valve comes off the cathode circuit, as usual.

The plate side of the phase splitter, however, is directly coupled to the grid of a second triode section acting as a cathode follower. The drive for the upper output valve is taken from this cathode circuit, thereby providing its grid with a low im- pedance signal source.

The whole arrangement can be made to look very simple by reason of a couple of happy accidents.

The lack of shunting on the plate side of the phase splitter triode in- creases slightly the signal voltage across this portion of the circuit. The increase is just sufficient to offset the slight loss in the cathode follower, resulting in an almost ex- act balance in drive to the two out- put grids.

WORKS OUT SIMPLY

Again, when using a general pur- pose twin triode, suitable operating conditions for the direct-coupled section are obtained by simply doubling the value of the cathode load.

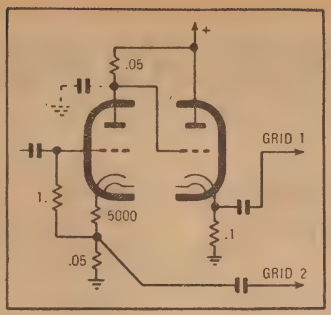
The direct coupling ensures a minimum of phase rotation while the nature of the circuit preserves it automatically from errors due to valve ageing, &c.

Is it perfect, then? What the world has been waiting for?

Unfortunately, no! The balance is excellent and automatic at all fre- quencies in the audible range, but it goes awry in the supersonic range —if that matters. The output valve driven from the plate side, gradually gets more and more drive, while its mate gradually starves.

The reason is found in what I've already had to say about input capa- citance.

If the cathode side of the phase- splitter feeds a triode or an Ultra-



Another and perhaps original contri- bution to the list of phase splitters. Like all the others, it has good features and bad ones.

Linear grid directly, it finds itself shunted by a capacitance of about 100pf. This acts as a cathode by- pass on the stage, gradually taking effect in the supersonic region.

As a result, the cathode drive falls away, the degenerative effect dim- inishes and the output on the plate side begins to rise.

There is nothing to limit this rise, either, because the plate side is shunt- ed only by the small input capaci- tance of a cathode follower stage.

To restore the balance it is neces- sary to bypass the plate with a capac- itor large enough to make up the difference between the input capa- citance of the cathode follower and the output valve it drives.

For a 6BW6 output stage (Ultra- Linear) the balance capacitor turned out to be 68pf, which added to cir- cuit strays, &c., would suggest a total effective input capacitance of 75 to 80pf. This for a relatively low Gm valve.

It isn't any hardship, of course, to add this capacitor, the only objection being that its value would have to be suited to the output stage. Once fixed, however, the balance should stay put at all frequencies and irres- pective of valve ageing.

Like the phase-splitter it could be upset only by a variation in two resistors, the plate and cathode loads. The resistor in the cathode follower could vary all over the shop without upsetting things, because of the self- compensating nature of the circuit.

Anyhow, there it is — a new phase- splitter (or I think it's new) which may be forgotten henceforth or taken up and credited for the sake of pros- perity to Yours Truly.

One more observation and I'm through. The curves we published last month showing the comparative performance of pentode and ultra- linear output stages did two things:

1) They demonstrated the super- iority of the ultra-linear connection, all other things being equal.

(2) They showed the pentode to be surprisingly good, nevertheless.

SPEAKER LOAD?

But remember one very important thing. All curves thus far have been taken into a resistive load, for per- sonal and social reasons. I don't know whether you've ever tried to conduct lengthy distortion tests, at full volume into speaker load. It isn't pleasant.

Only when such tests are taken, however, will the full story be told. I expect that the difference between the classes of operation will become greater. And how will the Ultra- Linear pan out when measured with a highly reactive load? Will it be nearly as good as a triode, or only half as good, or what?

And does it matter, anyway? Can one appreciate the difference, con- sidering the limitations of the rest of the system? I'm not sure of that right now, but it isn't relevant. As long as there's a fragment of distor- tion to chase or a tiny decibel to pick up, the amplifier fans will be after it, whether they can hear the differ- ence or not.

Now you must pardon me, I have to rewire my amplifier!

A further possible criticism of the circuit is that it contributes no more gain than the ordinary phase split- ter, yet uses a twin triode.

Agreed! Whether it matters or not, however, depends on circum- stances.

Plenty of amplifiers have been de- signed around the ordinary phase splitter, in which extra gain would only be an embarrassment. The amended arrangement could be sub- stituted very easily, a twin triode replacing the present single valve.

But, of course, there are other cases where gain is at a premium.

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GETTING YOUR AMATEUR LICENCE

This month we continue the discussion of aerial feedlines, and deal with the matched impedance type. These are used very widely in VHF work where separate aerial arrays are almost a necessity for each frequency band, and tuned feeders are not therefore practicable. However, they are quite widely used with aerials for all frequencies.

WHEN appreciable changes in frequency are required of a transmitter, including changing from one amateur band to another, the use of tuned feeders is valuable because in most cases we can arrange to tune the feedline and aerial to preserve resonance, and give an efficient transfer of power from the transmitter to the aerial.

In multi-band systems, therefore, tuned feeders are used almost invariably. By intelligent selection of aerial lengths, and feed line lengths, it is possible to ensure that the minimum amount of tuning need be done when changing from one frequency to another, and what there of it can be carried out with the least complication.

SINGLE BAND WORK

But where single band operation is concerned, or operation on suitably isolated bands, a different and very simple type of feed line can be used instead. It is known as the matched impedance, and is represented in common use by commercially made lines such as twin-lead or co-axial cable. Parallel, air spaced wires are used even more extensively.

The matched impedance feeder is a special type, and depends on the satisfying of special requirements for its operation. It's name really explains all. The word impedance, although generally used where AC is concerned, is here intended to mean a purely resistive component, without the appearance of any inductive or capacitive reactance.

It might be well to re-emphasise that resistance as found here, is not a tangible thing as is an actual resistor which we can measure on a meter.

We arrive at the value of resistances we shall be considering on an equivalent basis. The 72 ohms which appears at the centre of a half-wave aerial we know to be there because, if we were to replace it with a pure resistance, having no inductance or capacitance it will absorb the same amount of power as did the aerial and will behave electrically in exactly the same manner.

RESISTIVE POINTS

When we use the word impedance, from now on, remember that its nature is resistive, and its value at all times is the same as that of an actual resistor, assuming we could connect it in an equivalent manner to the circuit.

Therefore when we talk about matched impedance, we get the picture of connections to points which have a purely resistive character of a given number of ohms, and of a feed line with a resistive character which can also be expressed in ohms.

What do we mean by a purely resistive feedline?

A purely resistive feedline is one in which the energy fed to it is entirely absorbed, and none reflected from the circuit to which it is connected.

Such reflected waves could not appear, for instance, on a line which was so long that its length was infinite. Power fed to such a line would continue to flow away from the generator, which in our case is the transmitter, and there would be an unending movement of current out into the distance. This is not a practical case, of course, as the feed line we use must have a finite length.

But for every transmission line, we can find a value of resistance which, if connected to one end as the resistance of the load, will allow a complete absorption of power without any reflections.

When this happens, the value of the resistance is equal to what is called the surge impedance or characteristic impedance of the line. We don't need to carry out a long series of experiments to find this value, for it can be calculated if we know the spacing between the two wires, and their diameter. Every transmission line consisting of two elements has its own characteristic impedance.

To relate all this to a practical case, assume we have a length of twin-lead manufactured to have a surge impedance of 72 ohms. If we connect this line to the centre of a half-wave aerial where we know there is a resistive point of 72 ohms, and provide a coupling link to the transmitter at the other end, we have satisfied all requirements, and there will be an efficient tansfer of energy from the transmitter to the aerial without any complications of tuning.

LENGTH UNIMPORTANT

More-over the length of the feedline has nothing to do with the case. The whole circuit will exhibit an impedance of 72 ohms from the generator to the load, no matter how long it is made.

Connection of a 72 ohm line to an aerial is not confined to half-wave types. If the aerial is two half-wavelengths long, the feedline can be connected to either one of the 72 ohm points one-quarter wave from each end. The aerial can be extended from each side by the addition of extra half-waves without seriously affecting the method of feed.

A half-wave matched impedance fed aerial can be used at three times its original frequency without alteration. In this case, we have in effect three half-waves connected together, with the feed line connected to the mid-point of the centre half-wave, where, of course, there is a 72 ohm impedance.

The reason why the spacing and diameter of the wires determines the characteristic impedance of the line is that both these control the inductance and capacitance of the line for a given length. It is obvious that lines spaced close together will have a higher capacitance than those further apart, and if the capacitance is high, the inductance will be low. High capacitance lines will normally have a low characteristic impedance, and low capacitance lines a high impedance.

A 72 ohm line, therefore, will be made with wires spaced very close together—a piece of twin-lead is an example. A line of 600 ohms may have a spacing of several inches, and one of 200 ohms a spacing somewhere between the two.

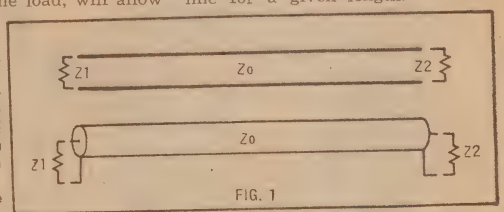

FIG. 1

Matched impedance feed lines may be either balanced (top) or unbalanced in the form of co-axial cable (bottom). In both cases, if a resistive point Z1 equal to the surge impedance ZO is connected to one end, a resistive value Z2 equal to Z1 will appear at the other end.

RADIATION LOSSES

The 72 ohm line will have a comparatively high capacitance per foot, and 200 ohm line considerably less, and the 600 ohm line a very low capacitance per foot.

The selection of a suitable line will depend on the use we have for it. We must consider the impedance at which it must be connected to the aerial, and the losses we are likely to experience.

The losses from high impedance lines in which the spacing is large are almost entirely radiation losses. Small though the spacing is, the fields round each wire do not completely cancel, and some radiation takes place.

Assuming the spacing to be four inches, this is a very small percentage of a full half-wavelength—about 132ft—at 3.5 Mc, and the radiation loss will be very small.

But at 50 Mc, where the half-

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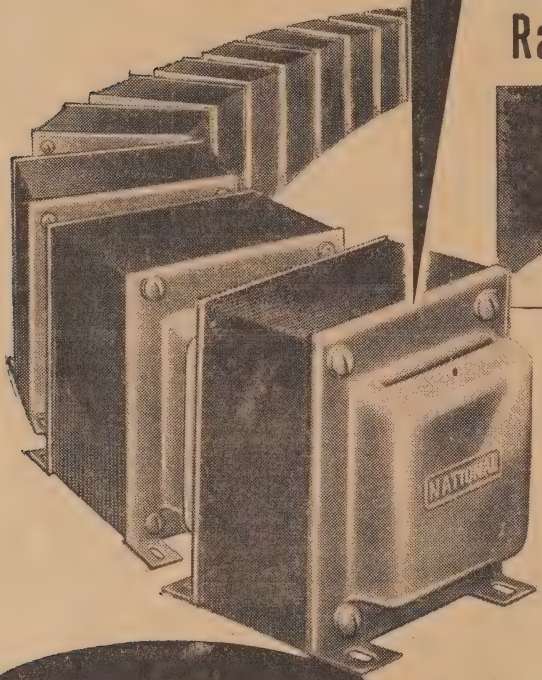

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velength is only about 9ft, the centage is very much higher. It uld be better to use a lower edance line to reduce the spac-, and one of 200 ohms would be ter.

t would be still better to go vn as low as 72 ohms, but here spacing becomes so small that is difficult to preserve an even aration. That is why we see such ags as twin-lead in which the es are embedded in an insulating pound which makes them phy-lly stable.

Infortunately, although radiation ses are reduced, this insulation a further source of loss in com-ison with the air insulation of open wire line. A 300 ohm open might have an attenuation per ft of .05 db at 7 Mc, to quote blished figures, but a 300 ohm gth of twin-lead might have .3 or six times as much. At higher quencies the discrepancy is still ger. These line losses are evi-iced by heating of the insulation ich can melt the compound if the e is incorrectly terminated and high voltages appear at points ng it.

PEDANCES

Summing up, therefore, the char-eristic impedance of the trans-ssion line is a function of the dia-ter of the wires and the spacing tween them. Wide spacing has higher impedance than close spac-. Wide-spaced lines with air in-ation have lower losses than close-ced lines with an insulating com-und. Radiation losses are large-dependent on the ratio between line space distance and a half-velength of the frequency in use. de spacing is suitable for low quencies, something less at higher quencies, and close spacing at ll higher frequencies. The im-dances generally used are 600, 200, d 72 ohms, although any value n be selected which suits our nditions.

What is the difference between spaced wire line and a co-axial ble?

In an open wire line, or twin-ad, the electrical characteristics each wire are substantially bal-ced. The current through each equal, but opposite in phase, and e capacitances to ground are the me. They are normally mounted that their distance from exter-l objects is the same to preserve is balance.

O-AXIAL CABLE

In a co-axial cable, the two wires e replaced by a single conductor mbedded in insulating material, and rrounded by flexible metal braid, hich forms the second conductor. ecause one side of the circuit is side the other, obviously the capa-tances to ground cannot be the me, and the line is, therefore, nbalanced.

The active surface of the outer nductor is actually the inside of e braid. The RF current does not ow on the outside of the braid, nd it therefore completely shields e inner conductor. This is an im-rtant point to remember when ying to understand the seemingly explicable operation of co-axial ible.

Provided the correct connections e made, the general operation of e two types is the same, although the co-axial cable has the advantage that the outside braid may be earthed without upsetting its efficiency.

Its losses are appreciably higher, because the dielectric used isn't as good as air. But carefully made, it can have an impedance as low as 30 or 50 ohms, and its efficiency can be held quite well up to 100 Mc and higher. Losses are generally

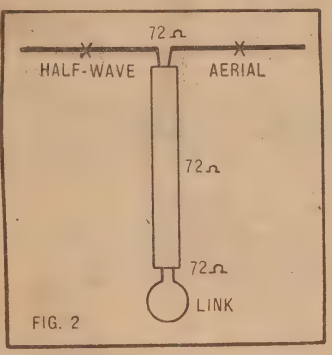

FIG. 2

The simplest use of a matched impedance line is to connect a length of 72 ohm cable to the centre of a half-wave aerial. A coupling link of smal size will provide the correct 72 ohm coupling into the transmitter tank coil.

quoted in decibels per 100ft, so that they can be assessed quite accurately.

The speed of radio wave propagation through the co-axial cable isn't as great as through an open wire line because of the velocity factor of the insulating material. This means that an electrical half-wavelength of cable is shorter than a half-wavelength of line or a half-wavelength of aerial. For ordinary co-axial cable it is only about 66 pc of the full measurement, and this must be taken into account in connections where such lengths are important.

The same thing is true to a lesser extent of twin-lead which generally

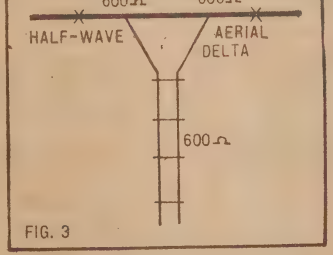

FIG. 3

A high impedance line can be connected to a half-wave aerial by spreading the end of the line to give a "delta" matching section. The correct dimensions can be easily obtained from standard formulae.

has less insulating material between the conductors, but it exists nevertheless. In the case of the simple feedline, we have seen that length is not an important factor, and has no bearing on operation. The velocity factor of twin-lead is about 85 pc.

The attachment of a co-axial feed line to an aerial isn't quite as easy as with a balanced line such as twin-lead, because, although we can provide an unbalanced connection at the transmitter by grounding the braid of the cable, we can't do the same thing at the aerial, where we require a balanced feed.

The unbalance will be caused because currents will now flow on the outside of the braid where they are not wanted.

There are several methods of providing compensation for this which will not be described here because they are shown in all the handbooks.

At low frequencies, where the ratio of aerial length to cable diameter is very large, and in cases where the aerial is very high, the effect of unbalanced aerial feed might not be important. But above 14 Mc it is worthwhile using one of the quarter-wave balancing stubs connected in one of the several standard methods.

We have now discussed most of the fundamental matters about matched impedance lines, and can consider how they may best be connected to the aerial and to the transmitter.

THE 72-OHM LINE

The case of the 72 ohm line is the simplest of all. We know that the centre impedance of a half-wave aerial is 72 ohms, and for that reason one of the standard cables has this value for its characteristic impedance.

At the antenna end it is only necessary to break the wire and connect one side of the feed-line to each half. But we have yet to connect it to the transmitter.

The simplest method of so doing is to connect the far end of the cable to a loop of wire, and couple this loop to the tank coil of the transmitter.

The loop of wire acts as the low impedance secondary of an RF transformer, the primary of which is the tank coil. The ratio between the number of turns used for each gives a step-down effect to match the 72 ohms we have at the end of the cable.

The impedance across the transmitter tank coil is comparatively high. Its exact value will depend substantially on the L/C ratio of the circuits, the type of valve used, and the degree of coupling to the aerial.

COUPLING TURNS

Because some of these things are variable with the transmitter adjustment, it is rather hard to calculate the right number of turns for the aerial loop, but it is generally quite easy to establish this by experiment.

The general rule is to use the fewest number of aerial coupling turns which will fully load up the transmitter. The loop will be placed at the low potential or "cold" end of the tank coil, or in the centre of the coil if the circuit is push-pull. Arrangements are made to vary the amount of coupling between the coils.

Too few turns or too small a coil will not allow enough coupling into the tank coil. Too many turns will not allow enough step-down to take place at a useful degree of antenna coupling, and the reactance of the

oling coil may be high enough add an unwanted component ch will upset the operation of system, which depends for its iency on pure resistive circuits.

is obvious that if our line had n of 600 ohms, a larger coup- coil would have been neces- to achieve the same result, as step-down from the tank coil uld have been of a much lower er.

he presence of the link at the of the feed line and its coup- to the transmitter does mean that mall reactance is introduced into circuit due to the inductance he coil. It is, therefore, common ctice to connect a condenser in es with one end of the coil, of h a value that its capacitive re- nce balances out the inductive stance of the loop, thus render- the feed point entirely resistive.

LANCING REACTANCE

f only one turn of wire is need- with a large tank coil, the un- nted reactance might be too small, worry about, but there will be es where it must be balanced to render the line perfectly flat. mica condenser large enough to ry the aerial RF current will be itable for low powered transmit- s, although a small variable could used.

he best method of finding the ht value is to note how much transmitter tuning is altered as aerial is coupled up. The nge will be due to the reactance earing at the end of the feed e, either from the coupling link ne or perhaps due to inexact tching at the aerial itself.

When the correct balancing con- ser is in circuit, and the re- ance removed, obviously the nsmitter tuning will not be altered ven the coupling of the link is ried, as there will now be no ctance to make any change.

Note that by this method, any re- ance in the feed line circuit can balanced out, so that it is real- an adjustment for the whole stem.

What happens if the resistance mination at the aerial is too large too small?

ANDING WAVES

In such a case, all the power nsferred along the line is not ab- bed by the load, and waves will reflected back along the line, ting up voltage and current nodes ong it. These won't be nearly high in value as if the line were ned, but their presence will cause me radiation from the line, and s of power. These waves are led standing waves, and their ap- arance and nature is exactly the me as the waves we have pre- ously discussed as apppearing along es fed with power.

In addition, their presence will use some reactance to appear at e ends of the line, although we n balance it out, if not too pro- unced, by adding series or paral- l capacitance across the link as eviously described.

In an extreme case it is not hard see that we will rapidly be re- rting to a tuned feeder and los- g all the advantages of the un- ned line.

If for some reason we desire to e a 600 ohm line, we can effect upling to the transmitter in the manner already described.

At the aerial, however, we are faced with finding two spots on the wire where the impedance is 600 ohms.

We have already seen that, with a resonant aerial, there is a whole progression of points from the centre to the ends which are resistive, and vary in impedance from 72 ohms to about 2500 ohms.

Therefore there will be two, one on each side of centre, where our requirements for 600 ohms will be satisfied.

It only remains to find them, attach our feed line, and the job is done. Note that we do not cut the aerial for this connection.

Normally a 600 ohm line will be spaced only a few inches, and the 600 ohm points may well be several feet apart.

So we provide a triangular matching section by opening out the ends of the feed line so that the sloping sides are about the same length as the space between the feed points. There are simple formulae for dimensions given in the various handbooks, and tables are available from which they may be extracted without being worried about long calculations.

There are other methods of coupling matched impedance lines to the aerial, but the examples given should cover any question you are likely to be asked in an examination. It might be an idea to learn the simple formulae for the "delta" dimensions, remembering that they are not quite the same for low and high frequencies.

Although we have used a 600 ohms line in our example, the same procedure holds good for any impedance of the feed line.

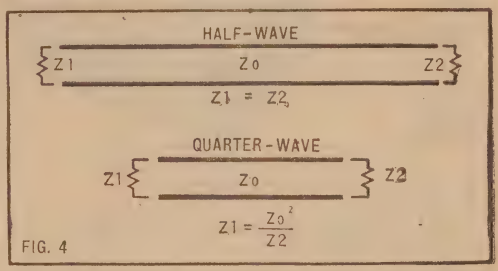

FIG. 4

Half-wave and quarter-wave lengths of line can be used as impedance transformers as described in the text. The general formula for each is given in this diagram.

FEEDLINE PICK-UP

An undesirable effect not always appreciated by amateurs is that, if the feed line does not leave the aerial at a right angle, so that its spacing from each half of the aerial is the same, it will collect energy from the aerial, and standing waves will appear on it which will cause it to radiate according to the amount of coupling present.

Thus it is possible to observe standing waves on a line which is otherwise correctly adjusted.

Always see that a feed line comes away from an aerial at right angles for as long a distance as possible, and at least for a half-wavelength at the frequency used.

The appearance of standing waves on the line through pick-up from the aerial will naturally be greatest if the feed line itself happens to be of a resonant length, that is, one which is an exact or nearly exact number of half-wavelengths.

Because the actual length of the line is not important, it is easy to make the line an odd number of quarter-waves in length, which as we have previously pointed out, represents the maximum degree of non-resonance. More liberties can be taken with such a line than with one which is of a resonant length. But remember that the length does not affect the line characteristics. Standing waves due to aerial pick-up are quite different from those caused by impedance mis-matching.

Is it possible to use a matched impedance line to couple resistive points at the feed-line and the aerial which have different values?

The answer is yes, and to understand it, we should examine some further interesting properties of feed lines.

Reverting to previous discussion on open wire lines, it will be remembered that points of high and low impedance repeat themselves at half-wave intervals along the lines. If we have a point of high impedance at one end of the half-wave, there will be an equally high impedance at the other end.

And further, if we were to measure the impedance in the centre of this half-wavelength, we would find a point of low impedance. All these points would be resistive.

It is also true that if we connect any value of resistance to one end of a half-wave feedline, we will find exactly the same value of impedance at the other, irrespective of the characteristic impedance of the line, provided that the resistances are not abnormally different from the line impedance.

And if we connect a high impedance to one end of a quarter-wave line, we will find a low impedance at the other.

LINE TRANSFORMERS

In this latter case, however, the exact value of this low impedance will depend directly on the characteristic impedance of the line.

In the case of the half-wave line, therefore, we have an extremely useful 1-1 ratio impedance transformer. But in the case of the quarter-wave line, we have an even more valuable variable-ratio transformer which, by selecting the right characteristic impedance, will allow us to match almost any value of resistance into any other value.

There is a very simple formula for this, and it should be memorised. If we call the source impedance Z1, the load impedance Z2, and the characteristic or surge impedance Z0, then Z1 divided into the square of Z0 will give the value of Z2.

Let us suppose we have a quarter-

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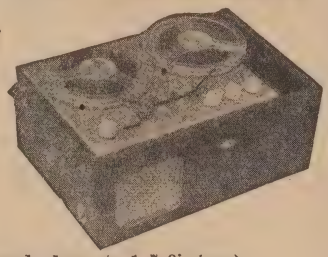

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e section which has a surge im-
nce, Z0, of 50 ohms.
one end of this section were
nected to a resistance of 250 ohms,
would find a resistance of 10
s at the other end, because the
re of 50 is 2500, and this figure
ded by 250 is 10 ohms.
we had connected 100 ohms in
e of the 250, then at the other
we would find 25 ohms. If the
resistance had been 50 ohms,
same as the surge impedance,
the other end would also be at
ohms and the line would be a
nal section of a matched imped-
e feed line.
ow we can re-write this simple
nula in order to find any third
stance value provided we know
other two.

E IMPEDANCE

oming back to our original ques-
, therefore, we see that if we
e two unequal resistive points
ch require matching by a feed
, we can find the surge imped-
e of the line we need to do the

magine we have a length of 600
line which we wish to connect
he centre of a 70 ohm aerial. In
ordance with our formula, we
ld multiply these two figures to-
ner, getting 42,000. The square
t of this, a little over 200, would
the surge impedance of the
rter-wave transformer required.
culation or reference to tables
ld quickly give us the dimen-
ns of a 200 ohm open wire line.
his method of transforming im-
lances is widely used in aerial
rk, particularly when many ele-
nts are connected together in dir-
ional arrays, and some awkward
istance values result at various
d points.
he general idea is just as appli-
le to co-axial cables and twin-
d as it is to open wire lines.
n interesting case applied to the
rter-wave transformer occurs if
end is short-circuited so that
impedance at that point is zero.
he impedance at the open end
l now theoretically be infinity, but
cause of electrical limitations, will
fact be many thousands of ohms.
We could therefore use such a
gth of line as a support for a
dline, and even if the shorted end
re to be connected directly to
ground, the feed line would be
ulated just as effectively as
ugh we had used a standard type
insulator.
f you study your Handbooks you
ll find many examples of the use
"quarter-wave insulators" as they
called, particularly as applied to
F aerial systems and feed lines.

echanical hypnotist

CHICAGO electronics engineer
has invented a mechanical hyp-
tist.
The machine's inventor, Neil Slat-
, 40, said that it had been tested
a large Chicago hospital.
It operates with a rhythmic sound
chronised with the rate of
eathing.
The machine will lull the average
bject to sleep within 20 minutes.
Two years ago a Chicago obste-
ician told Slatter that present
ethods of auto-suggestion and
pnotism often took up to two
urs.

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

Questions are frequently asked us about the use of small metal rectifiers—how they should be connected with circuit &c. This useful article on the subject is contributed by Mr. A. D. Patch, of 122 South St., Rydalmere, NSW.

MANY of the small electric motors today are designed to operate from torch batteries or a similar DC supply voltage. This means that there must be a ready store of batteries on hand or that you have to keep using those few extra shillings each week to buy more.

This trouble can be overcome by using a rectifier, which changes alternating current to direct current, and this in turn can then be applied to the model or whatever it is that requires it.

Rectifiers consist of small discs of iron with a coating of selenium, or copper with a coating of copper oxide. They are bolted together in such a way that the current can only flow through the complete unit in one direction—known, therefore, as unidirectional current flow.

There are three common arrangements for a rectifier supply, using rectifiers which are popularly known as "single-element", "double-element" (or full-wave), and "four-element" (or full-wave bridge).

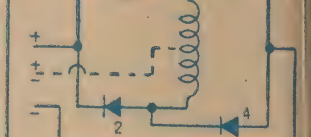
Of the three, the last-mentioned is most common, and in the long run is usually the cheapest to buy, since it can be used in circuits involving the other types as indicated in the accompanying drawings, figs. 1 to 3.

Each of the insets to the figures shows the actual physical layout of a full-wave bridge-connected metal rectifier, and the letters marked against the contacts or lugs on it indicate the connections and arrangements in the respective associated circuits alongside.

The circuit of fig. 1 shows the connections required to use a bridge rectifier as a half-wave rectifying circuit, using only two of the four elements available, and connecting the two in parallel to provide a greater current rating—half the current flows through each element used.

Do not be confused by the number of lugs on the rectifier and imagine that all five have to be connected somewhere.

Note that the side connected to the transformer is generally known

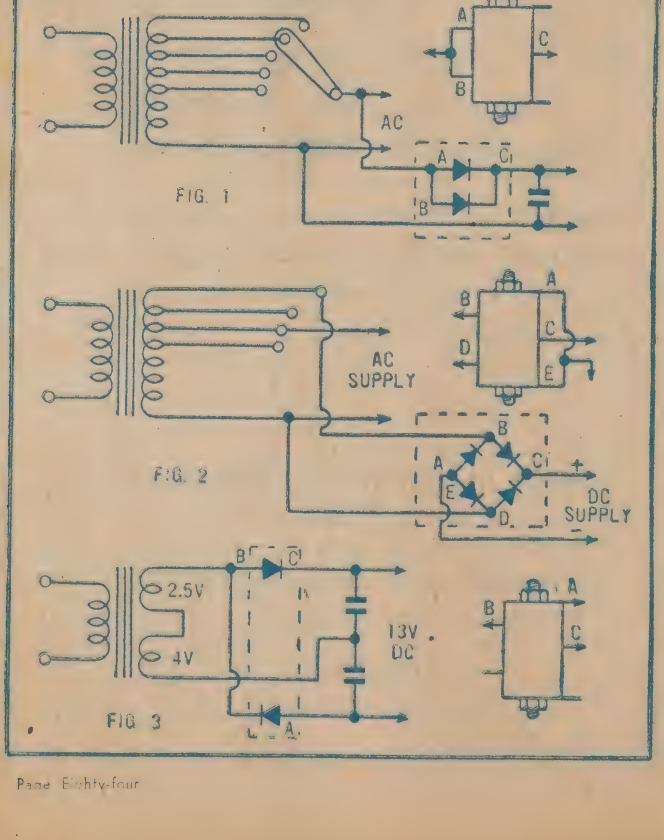


(a)

as the "input", and that which goes to the external motor or model, the "output". In fig. 1, the input is via a tapping switch on a small transformer such as those used to operate toy trains. Do not connect the small rectifier of this type to the mains voltage.

In figure 2 the full-wave bridge rectifier is shown connected in the circuit for which it is designed. How this circuit operates and provides a relatively smooth DC output is best understood by studying the sketch (a).

In this sketch, it is assumed that the transformer supplying the rectifiers has a centre-tap (dotted connection), and that the rectifiers are connected just as in the case of fig. 2. The circuit may be unrecognisable in this form at first, but trace it out and it will come clear.



OUTPUT VOLTAGES

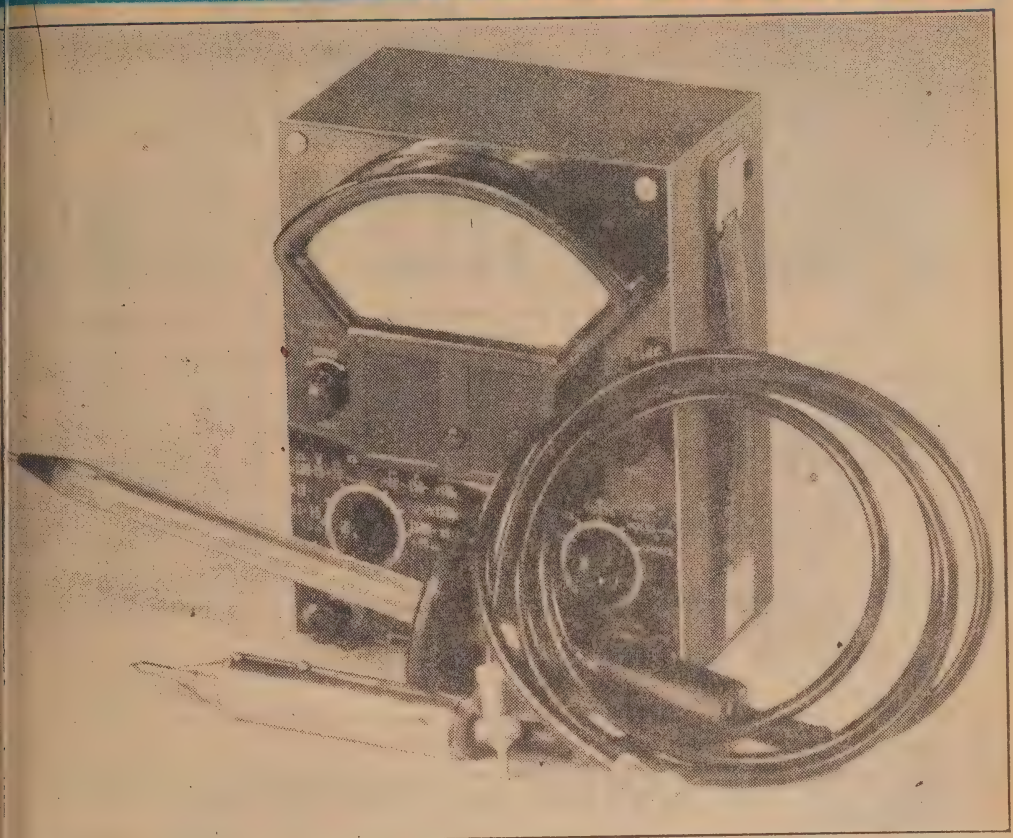
The rectifier elements "1" and "2" are connected to form a full-wave circuit and their output will be half the total voltage appearing across the whole transformer winding, and will be positive with the centre-tap.

The other two elements "3" and "4", however, are connected in the reverse direction; their output will be half the total voltage of the transformer, but in this case it is a negative voltage with respect to the centre-tap.

Now remove the centre-tap—which is not there in fig. 2, and compare the voltage across the out

(Continued on Page 105)

TRADE REVIEWS AND RELEASES



Paton Electrical presents an entirely new electronic voltmeter suitable for AC and DC measurements in radio, television and other electronic equipment. The high input resistance of 11 megohms makes it ideal for measuring potentials in high impedance circuits without influencing conditions.

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The 6in sector type meter permits accurate and easy readings, all AC and DC voltage ranges are linear. The scale is printed in three colors.

RANGES:

DC Volts. Input—11 megohms. 0/1.5, 5, 15, 50, 150, 500, 1500 volts (50 KV with HT probe).

A.C. volts. Input—1 megohm parallel with 90 pf. 0/1.5, 5, 15, 50, 150, 500, 1500 RMS.

Decibels. 0/4.2, 14, 42, 140, 420, 1400, 4200—peak to peak.
—30/—3, —10/+17, +10/+37, +30/+57 (odb equals 1 mw across 600 ohms).
—20/+4, 0/+24, +20/44, +40/+64 (odb=6 mW).

RESISTANCE: All ranges operated from internal battery. 0/1000, 10,000, 100,000 ohms. 0/1, 10, 100, 1000 megohms.

POWER SUPPLY: 220-240V 40-60 cycles.

METER: 6in sector type.

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One DC probe with 1 megohm resistor built-in and shielded lead.

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One earth or common lead and probe.

One ohms lead and probe.

SPECIAL ACCESSORIES (Available at extra cost)

Crystal probe and lead for RF use up to 250 mC.

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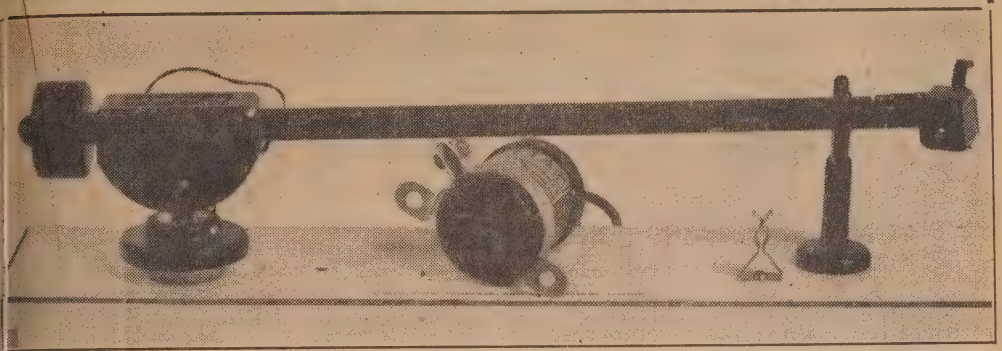
NEW LEAK PICK-UP HAS IMPRESSIVE PERFORMANCE



The new model Leak moving coil pick-up complete with transformer.

Amplifiers made by H. J. Leak have achieved considerable fame throughout the world for their quality and high performance. Equally famous in its field is the Leak moving coil pick-up which has been designed to the same standards as other Leak equipment.

ING a quality component the Leak is not cheap, but it can obably be numbered among the st commercial designs in the world. Many high quality pick-ups are too gile to stand the hurly-burly of rd use, as, for instance, in a broad- st station. On the other hand many rdy pick-ups, because of their ut construction, have a limited rformance.

Although the Leak isn't something e would hit with a hammer, it thstands private and studio work all kinds, and is widely used iere flat response and low distor- n are essential.

The Leak, which is shown in the otograph above, is a moving coil kup with a tiny, enclosed move- nt of very low mass. It is mount- in a small, shielded head which gs into the supporting arm. Two oes of head are available, one for ndard and one for LP records. They slide into the arm with a ide slot to ensure correct location contact pins.

Each is fitted with a diamond sty- s for extremely long playing time fore replacement. This is nor- ally done by returning the head r service, and the stylus is not re- aceable in the normal manner.

The arm is accurately made, and lies on counter-balancing head eight to obtain the correct stylus essure, which is only about 4 ams. This is made possible by the tremely high compliance of the stem, and its low mass.

Output from the head is low, and fed through a transformer to step o the voltage for use with the av- age amplifier. It has adequate tput for all standard types, includ- g the Playmaster series.

The pickup arm has a single hole ounting, and the lead from the ansformer plugs into the end of e base below the motor board. hus there are no wires hanging om the arm itself. Leads to and om the transformer are shielded. he transformer is also shielded and ay be mounted in any position to avoid hum pick-up from other equipment.

Hum pick-up by the head itself is very low, and the movement is not unduly sensitive to motor rumble.

The performance of the pick-up is not bettered by any other type we have tested to date. Its waveform with either head is virtually perfect throughout the range, and resonances if any were too high to be accurately observed with normal test records. For practical purposes it is "flat".

Reports on IM distortion were most encouraging, and again the Leak returned a figure almost too low to be measured.

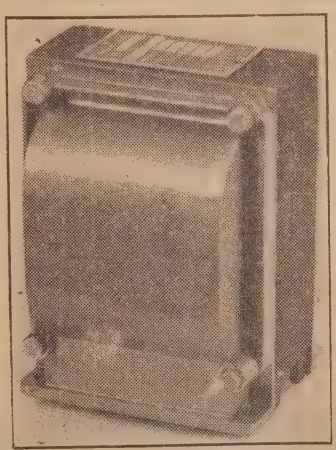
The diamond point has no difficulty in tracing all our test records and it plays with a clean, crisp quality which is a delight to hear.

The Leak pick-up and other Leak products are handled by Simon Gray, of Elizabeth St., Melbourne, who submitted the sample for test.

A & R ULTRA-LINEAR TRANSFORMER

An ultra-linear transformer made by Anderson and Rudie of St. Kilda Rd., Melbourne, has been sent to us for test, and has shown itself to be of the highest quality.

THE transformer is similar to a 6600 ohm primary impedance type which the firm has been making for some months, but is wound with a primary impedance of 4500 ohms to suit the 17-watt ultra-linear amplifier described in our last issue.



The A & R 20-watt ultra-linear transformer

Its type number is OT931-15, it has a maximum level rating of 20 watts, and its output impedance may be either 3.7 or 15 ohms by suitable inter-connection of windings.

Its response is given as 16-60,000 Kc, and this probably applies to its use in an amplifier with adequate feedback.

GOOD ON TEST

Tested in the original ultra-linear amplifier, this transformer showed itself to be in the highest class. Its response was perfectly flat from about 40 cycles to 100 Kc, the highest frequency used for test, and was less than .5 db down at 20 cycles. These figures are for the complete amplifier.

Overshoot and ringing on square waves were virtually absent, and when connected for pentode operation, results were equally good for this type of service.

It is a transformer suitable for the most exacting design requirements.

The plate-to-plate impedance is suitable for valves such as the EL37, KT66 or 6L6, connected either as pentodes, triodes or ultra-linear. It would also suit 2A3's in their 5000 ohms impedance rating.

It is finished in grey hammertone, with cast clamp casings. A terminal strip is provided for connections.

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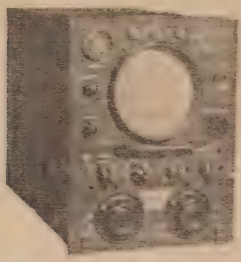

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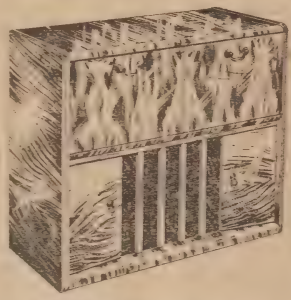

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SCOTCH ELECTRICAL TAPES

W. J. McLellan & Co. Pty Ltd. have sent us specification of Scotch Electrical tapes for which they are distributors. Type 33 is available now, and types 16 and 27 should be available shortly. Here are the details.

DURING the last five years, "SCOTCH" Electrical Tape No. with plastic backing has been ed with complete success and a at saving in application time for ctically every type of electrical ulation, except where heat of re than 176deg F. will be en- ntered.

t has a stretchy rubber-like plas- backing that allows the tape to pulled down tight and conform irregular surfaces. It has high istance to oil, moisture and acids, s not check or crack in sunlight, n, snow or other weather ditions, and resists abrasion. This e contains no sulphur bearing npounds and does not introduce y corrosive material into an elec- al assembly.

No. 33 Tape is excellent for wrap- ng splices, binding wire harness, It is used widely in electrical nstruction and repair, and does e work of a rubber and friction e combination. The thinness of tape prevents the overstuffing junction boxes and fixture open- gs.

It is particularly suitable for such ecialised installations as explosion oof fixtures on gasoline fuel mps, gas pipeline control junction xes, &c.

"SCOTCH" No. 33 Tape has been proved by Underwriters Labora- ies Inc. and will shortly have proval of local authorities in Aus- ilia.

APE No. 27

"Scotch" Electrical Tape No. 27 th glass cloth backing and thermo- tting adhesive is for use in high at locations where the adhesives other tapes cannot stand the ex- eme heat. This remarkable tape as easy to apply as any "Scotch" essure sensitive tape and serves l purposes of sealing, holding and sulating. The glass cloth backing nnot burn and the thermosetting dhesive does not melt when sub- cted to high heat.

Instead, when subjected to 250deg for two hours, or 300deg F. for ie hour, the adhesive cures, form- g a permanent bond of great rength. In curing, it increases its electric strength by about 500 volts. fter the completion of the curing rocess the adhesive is not affected y normal high temperatures and resents strong resistance to solvents.

The backing of "Scotch" Electrical ape No. 27 is glass cloth (spun and oven glass fibres). This glass cloth alone in its class as an insulating aterial. It has very high tensile rength and, as stated, is not armed by high temperatures or oisture and will not shrink, stretch, ot or burn.

(Continued on Page 112)

OFF THE RECORD — NEWS & REVIEWS

One of the most elaborately presented record sets comes from Mercury, and is now available—a complete recording of the Nutcracker Suite with a de luxe album beautifully illustrated and with a full set of programme notes.

By JOHN MOYLE

THE records themselves have achieved almost a measure of fame overseas and Mercury is just as certain that they will be equally successful here.

Most high fidelity fans are already familiar with the Mercury sound on discs, and know how brilliant it is. Some of the most striking records ever released have come from this studio.

In selecting the Nutcracker for such ambitious treatment, the local factory has shown good judgment. Almost from the earliest days of electrical discs, a Stokowski recording of the well known suite taken from the ballet was a best seller and is still played today in many homes and radio stations.

It is a perfect example of bright, tuneful and imaginative music with a story, and tells it with a directness and color which is completely intelligible and is seemingly everlasting in its novelty.

On these two discs we have the complete work, not merely a suite of half-a-dozen pieces. Many of them will be new to most listeners, but they are just as welcome as the familiar highlights.

The Chinese, Arabian, Sugar-Plum Fairy and the Dance of the Flowers are all there, and you will be intrigued with their new interest when heard in full context.

The recordings can be summed up by two words—balance and brilliance. Mercury's technique gives a sharply etched outline which often dazzles in its accuracy. Somehow they have managed to balance up every instrument in the book so that each one sounds in just the right proportion and with the utmost realism. The tiniest touch on the triangle is heard as authentically as the harp, the celeste or the tympani.

At the same time there is an atmosphere which binds them all together so that musically they are always part of a whole sound.

My own reaction is that, in managing all this, there is some lack of body in the recording. I added a notch or two of extra bass, which succeeded in balancing it better to my ear. Some who don't like their sound so sharp might go for an NAB curve, but the AES is the one for "the works" if your gear is good enough.

Some of the effects are most demanding on the pick-up, but I had no trouble with groove hops. The gunshot heralding the battle with the mice is an object lesson in clean, hard sound.

We will be looking forward with a good deal of anticipation if Mercury can keep us supplied with more records of this quality.

MOZART—Clarinet Concerto in A major KV 622, played by Richard Schonofer and the Wiener Symphoniker conducted by Bernhard Paumgartner. Philips A00698R.

This is a record to which I attach five stars with no compunction at all.

Mozart's clarinet concerto is well summed up by a paragraph from the cover note. "The Clarinet Concerto is characterised by an incredible warmth of tone, and is dominated throughout by the close relationship between the soloist and the orchestra, and the perfect balance in the interplay and complementary integration between the two, which demonstrates the unmatched perfection of Mozart's late style in every bar."

That this work should achieve such a stature is remarkable because the clarinet had scarcely arrived on the scene as an instrument of any major importance. But Mozart shows a complete appreciation of its unique range and character as though he had been familiar with it all his life.

Not only is the music among the loveliest of Mozart's work, but the recording here is well-nigh faultless. Every time I have played it, I have liked it better.

The clarinetist, who is new to me, possesses an extremely beautiful tone, and achieves an unusually consistent quality through the range. I would say that in string to capitalise on these assets has perhaps sacrificed some brightness, particularly in the last movement, but he has carried out intentions so well that I would penalise him for that.

Of the orchestra I can only say that it is equally as good. It plays from a completely silent surface with warmth and superb balance. It isn't a wide range record in the fullest sense, but it is so perfectly done that I wouldn't change a thing.

If you don't snap up this one don't blame me!

SIBELIUS — Concerto for Violin and Orchestra Opus 47 played by Jan Damen and the London Philharmonic Orchestra conducted by Eduard van Beinum. Decca LXTA2813.

This is a magnificent work with a voice and a stature all its own. It is a violinist's concerto. Right from the first magical bars he has the floor and the responsibility that goes with it. On his shoulders lies the main announcement of broodingly passion and tender beauty that has in the air and strike one to silence and quiet. It is a most demanding test both technically and musically.

In this recording I thought that both the orchestra and the soloist were eminently successful in achieving the mood of the work, but that the orchestra carried off the honors.

Damen is one of those violinists who never seems to quite get there. He knows exactly what he is after but his ability to throw off the notes with certainty and truth is just not good enough to be first class and tends to keep us on tenterhooks as he occasionally battles with the viciously demanding score.

GOOD SIBELIUS

On the other hand, a good deal of it is beautifully and most sensitively played, and it is quite definitely the way Sibelius should be heard.

The violin he uses has a strong almost husky lower register which is used most effectively, and the top string, while quite sharp in tone, is not unduly shrill.

The orchestra is first class. The recording has a full body, and woods, wind and brass, which the composer uses freely, could scarcely be bettered. They handle that vicious bit so characteristic of Sibelius with razor-sharp attack. From beginning to end their vitality never flags.

My copy exhibited a few whiskers near the end of each side which the average machine may not notice, and which might not appear on them all. It is the only obvious flaw I could notice.

The balance is quite OK for the

a setting, but the EMI rounds the top and many will like it best t way.

BRAHMS—Concerto No. 1 in D minor Opus 15, played by Wilelm Backhaus and the Vienna hilharmonic Orchestra conucted by Karl Bohm. Decca XTA2866.

My first reaction to this record s one of some disappointment, inly on the recording side. The eral sound seemed thin and unvincing, particularly when the hestra was under pressure. Quite it of the score is virtually unheard ough the strings — woodwind stly—and much of the light and de doesn't register.

The performance, however, is far good to be dismissed in any way ail. Although Backhaus must ve been about 70 years of age en it was made, it is astonishing w little the years have affected mental approach and physical ecution.

t is a performance of authority d maturity, shaped as it should be, d given out with great power and derstanding.

doubt whether there is any ing pianist, except perhaps Gieseg, who can play Brahms like this.

After a while I began to play about th compensation, and found that ich of the edginess which first hit could be tamed by using the EMI ting with some bass boost—someng like NAB in fact. It gave the hestra a body which previously med lacking, although it could t raise the balance to what I con-er first class.

don't want to appear fussy on s point, because the recording 't one you should pass over, and I think the best all-round version have heard so far. It's just that I n't think it is that five-star winr we are all looking for.

The surface noise is quite low on e NAB setting. The orchestra is in od form, and the piano, although times competing with the orches-, has a good, concert-hall atmosere and body.

BEETHOVEN—Concerto No. 5 in E flat major Opus 73, played by Wilhelm Backhaus and the Vienna Philharmonic Orchestra conducted by Clemens Krauss. Decca LXTA2839.

Many of the remarks I have made out the Backhaus Brahms also ply to this record except that the cording is a better one. It is not cessary to pick your compensaon to supply the orchestra with dy, and its balance I thought much tter. This is strange, as it is obably that they were both made out the same time, but that's one the unpredictable things about cords.

I still suspect, however, that the rings have a little bit of top which esn't completely belong, because, in the Brahms, the muted passes don't sound as muted as I ink they should. Many Decca cords seem to be this way.

The piano seems here to be in mewhat better proportion than in ie Brahms—it is never anything iat it shouldn't be. I liked the acious atmosphere, particularly in e second movement, and every note clearly heard.

The performance is good — very od. I am prepared to admit that ere is evidence here of Backhaus' mewhat aloof, impersonal approach, but as always he knows exactly what he is doing, and that's his kind of Beethoven.

Strangely enough, for a pianist who is never wanting in a vigorous approach, there seems to be a lack of drive at times in quite obvious places, in which his playing becomes almost diffident.

But it is the Emperor I would pick of those I've heard, and I don't hesitate to commend it.

Wide range machines may note that the piano comes perilously close to a ragged edge on an odd occasion, and for that reason might prefer to use an EMI compensation. The surface, too, isn't dead quiet, but neither of these things is bad enough to be considered a major defect.

RAVEL—Bolero. De Falla, Three Dances from the Three Cornered Hat. Played by the Symphony Orchestra of the Belgian National Radio Institute, Brussels, conducted by Franz Andre. Radio - Telefunken LB6058.

A pleasant but not brilliant recording of three dances from the ballet and a full-length performance of the very long Bolero.

The latter starts at a somewhat higher volume than normal, and the climax is toned down so that the overall dynamic gradient is lower. This lessens the drama but makes for easier listening.

It also avoids a long session of very quiet playing, during which surface noise must be extremely low for good effect. Not that this surface is bad.

In fact, it is an easy going recording right through—a little more bite would have supplied profitable excitement in some passages.

BEETHOVEN—Violin Sonata No. 5 in F major Opus 24 (Spring): BRAHMS — Violin Sonata No. 3 in D minor Opus 108. Played by Christain Ferras, violin, and Pierre Barbizet, piano. Radiola - Telefunken LE6501.

This is a competent, well-tempered record both technically and musically.

I liked the Brahms the better of the two. The Beethoven needs, I think, somewhat firmer handling, although the quiet, relaxed approach is held consistently and is by no means out of place with music of this mood. The colors of the Brahms are a little deeper, and both players treat them gracefully and with appropriate insight.

Instrumental balance is good. The violin is rather forward, and takes an edge in the upper register which makes the EMI setting the best, while an NAB adds some warmth to the piano tone which builds its weight to better proportion.

This type of record calls for a very quiet surface, and I can give it full marks on this score. As a result, the violin stands well out into the room, a shade too much when the bowing is light. It would have been a little smoother perhaps if positioned further back.

Nevertheless, the net result is of really good quality, and it can be relied upon to play smoothly on any equipment.

MOZART — Twenty Dances for Orchestra, K534, 600, 602, 606; KV609. Played by the Vienna State Opera Orchestra conducted by Franz Litschaeur. Nixa VLP426.

This collection of bright and tuneful dances contains the interesting evidence that Mozart was indebted to them for many melodies incorporated in his other works—operas and symphonies—melodies which, as the jacket notes point out, we have been accustomed to regarding as typically Mozart.

Many of them are quite short, and this tends to make them sound a little scrappy when played right through, but then they were not intended to tie together as a complete opus. In any case they make very easy listening, and will delight musicians and students alike. Many of the orchestral imitations—the organ grinder, birds, and sleighbells —illustrate an unusual angle to Mozart's musical imagination.

The recording, which is probably a Vanguard original, is clean and well balanced, and plays best with an EMI setting.

The surface demands special mention, for it is almost completely silent. Reverberation is a little more than usual, and it sounds really fine on wide-range equipment.

RIMSKY - KORSAKOV — Symphonic Suite "Antar" Opus 9, Russian Easter Festival Overture Opus 36, played by the London Symphony Orchestra conducted by Hermann Scherchen. Nixa NLP910.

Technically the most impressive recording of the month. It has brilliance matched only by the Nutcracker Ballet, but a great deal more weight and body, due probably to a

more forward microphone placement.

Despite the heavy cutting it plays cleanly, and there is terrific impact, particularly in the brass in the Easter Festival. If your equipment has a few watts to spare and a good speaker system, you'll know what I mean in the first inch of playing time.

The only minor defect I can quibble about is some groove echo in obscure spots where the micrograding has been beaten, and a few surface crackles which only show up on the quietest passages because of the enormous dynamic range.

The Festival is a brilliant show piece which could easily take its place with the Planets and Belshazzar as some of Nixa's best and vastly improved work.

The symphonic suite Antar is unknown to me, and although as suggested it has something of the Scheherezade atmosphere, it hasn't quite the romantic pull of that famous concert piece. It is recorded on the same vivid scale, with a full frequency and dynamic range, including some thunderous bass and delicately balanced treble.

Altogether a first-class release. But watch the labels—on my copy they were obviously reversed.

BEETHOVEN—Symphony No. 1in C major Opus 21, Symhony No. 8 in F major Opus 93. Played by the Vienna Symphony Orchestra conducted by John Pritchard (First) and the Berlin Philharmonic Orchestra conducted by Paul Van Kempen (Eighth). Philips AOO179L.

There is a great similarity on broad lines with Decca's recording conducted by Schuricht which was released a month or two ago.

Concerning the First symphony, the same orchestra is used, but there is a subtle difference in the microphone placing. This gives a little more bite to the Decca, which uses a slightly closer technique.

The performance is much the same for each, although Pritchard takes the first two movement at a faster pace, and has a sense of hurry which makes Schuricht sound almost leisurely. They are both good, but Decca's is the more forward and has greater body. Philips sounded best with an NAB curve.

In the Eighth, there is a change of quality in each case. They are both more massive, particularly the Philips, in which the orchestra sounds almost as though an octave had been added. There is much more reverberation, and the Berlin orchestra gives a big performance which, although a little muddy at full volume, is quite impressive. I liked this side better than the Decca.

The surface also is a bit quieter, and it sounded very well on an AES setting, in which the strings are sharper to balance the stronger bottom end. There is plenty of drive and life to it—never a dull moment. It is surely one of Beethoven's finest symphonies.

STRAUSS—Album of Waltzes by Johann and Joseph Strauss. Played by Mantovani and his Orchestra. Decca LKA4054.

A particularly fine record in the sense that it succeeds completely in what it sets out to do—to present the best known Strauss waltzes with plenty of vitality and swing. Mostly they are played "straight", although on one of them we hear the typical Mantovani echo effect, which is by no means out of place.

The recording is just what the music needs—enough reverberation to give weight and color, and with a crispness that shows off the orchestra's attack and precision.

The frequency range is quite wide and well proportioned. Everything is clean, and the disc plays sweetly throughout.

A very good effort which everyone will like.

DVORAK—String Quartet No. 3 in E flat major, played by the Vienna Philharmonia Quartet. Radiola-Telefunken LB6061.

This quartet, known as the "Dumka", from Dvorak's own description of the second movement (a Slavic ballad form) is one of his most popular and tuneful works, and is essentially Bohemian in its atmosphere. It is characteristic of Dvorak beyond all doubt, although it shows strong evidence of his link with Brahms, a link even more obvious in some other compositions.

It is competently played, but the quartet is not always the smooth performer we expect from front rankers. The instrumental blend frequently breaks up with the ... of a scratch combination rather ... an experienced team.

Some of this may be due to ... recording, which achieves a hu... quality but somehow leaves ... cellist rather in the cold.

It has an advantage, howe... in that it is complete on a sin... 10in record, and I doubt whet... there is another one current h... at the moment. Like most Radio ... it has a smooth, quiet surface, ... should sound well on almost ... machine.

HAYDN—Symphony No. 53 i... D major, Symphony No. 67 i... F major, played by the Vienn... Symphony Orchestra conducte... by Paul Sacher. Philip... A00181L.

Haydn wrote such a vast num... of symphonies that many of th... are unknown to the listening pu... lic, and there is more than a s... picion that there are some not ... unearthed, if indeed they still ex...

Many of them are formalised s... of unequal value, but the best ... them are vastly important, not o... for themselves, but as illustrat... the growth of the symphony, wh... made such strides under his han...

One of these better known wo... is the Opus 67, serene in its mati... ity and containing many interest... features of composition. The p... formance of the Vienna play... could scarcely be bettered as he... on this disc. It is beautifully judg... playing, clear in outline, respons... and sensitive, bright and livi... when called upon.

The recording is rather light ... character, with a remote microphc... placing which, although precludi... extreme brilliance, allows the mu... to float in a true concert atm... sphere. You won't find this a d... play record, but you will find ... filled with fine music, balanced ... sound and responsive in perfor... ance.

The D major is one of the less... known works, and is well annotat... on the record cover. Its recordi... is of the same standard as the ... major.

I found the NAB setting sound ... best. There is no surface noise.

K. P. E. BACH—Sinfonia in D major, Sinfonia in C major, Piano Concerto in A minor. Played by the Vienna Symphony Orchestra conducted by Henry Swoboda, pianist Franz Holetscheck. Westminster WL5040.

Some day someone will write ... story about the Vienna Symphor... Orchestra and its recording activ... ties. There isn't a shadow of dou... that it is the most important co... lection of players using the micr... phone at the present time, and ... reviewer runs out of adequate d... criptions of what it can do. I ... versatility is immense, and its stan... ard invariably of the highest. Mere... to choose records by the Vienr... players would be to build a repr... sentative library.

Here we have it again in thr... works by the son of J. S. Bac... whom many consider a more im... portant musical figure than his illu... trious father. To assess his influ... ence on Haydn, so often called th... father of the symphony, is to rea... a lesson in musical history, an... Westminster have done a pret... good job of that in their typicall...

written and authentic cover
s.

tracing symphonic growth
n to Beethoven, Karl must be
ored for his part in breaking
y from the strictly contrapuntal
ical thinking to the use of
nonic or vertical writing, as well
or many other things he used
point the way for others who
e after him, not forgetting the
mparable Mozart.

or all this, and for the music
performance of it, this record
relcomed, and its merits lie not
in historical values but for its
fresh unsophisticated appeal.
have not only two examples of
ely instrumental writing, but a
erto for clavier as well.
he recording isn't as forward as
e Westminsters, but it is of a
standard nevertheless. The
ace is quiet and it plays through
ease.

DELIUS—In a Summer Garden—Over the Hills and Far away. Played by the Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. Columbia 330C1017.

hese two little tone poems of
ius are separated in time by
ut ten years, and they show the
erence in their texture. The
mer Garden is a more solidified
ius, if so glutinous a word could
be applied to his music, and
the better known of the two.
pled together, they make a duo
ch is hard to resist.
he performance, as we would
ect under Beecham, is virtually
itless, and the recording has lost
hing of what was meant to be
re. Great care has been taken
balance the orchestral soloists,
always play such an important
t in a Delius score. And yet the
nd of the complete orchestra is
d warmly and clearly even as it
es down into inaudibility.

he improvement in EMI surfaces
fortunately maintained here, for
slightest distraction would have
n intolerable with music of this
d. However, it is a completely
nt surface job, and played quiet-
with a little bass boost, or a
B curve, it prouces truly lovely
nd.
n short, as good a Delius record
you are likely to get.

RAVEL—Bolero, Alborado del Gracioso, Pavane, La Valse and Rhapsodie Espagnole. Played by the Radio Symphony Orchestra of Paris, conducted by Rene Leibowitz. Festival-Vox FFR12-509.

A comparatively small studio
ms to have been used for this
ording, with a short but well-
ged time constant. This is in
ping with the general mood of
music, for there is much deli-
y of sound which would tend to
t off in a big hall. For the most
t it is clear and vivid.

would have liked a more for-
rd bass in some of the items,
ably the Pavane, which sound
her "middly" through lack of low
quency support. The same gene-
character made the Bolero, which
very heavily cut, a bit rowdy.
is livened up by a few weighty
m beats at the end, although
drummer is obviously a bit
aid of beating himself out of the
oves.
Musically, I liked La Valse and the Rhapsodie best, but I did not think any of them were superb examples. The Pavane, which everyone knows, missed its essential character, and was not smooth enough.

The surface is mostly quiet on the average, but my copy had a few noisy spots. I found the NAB setting best.

POPULAR HI-FI

It seems almost an irony that some of the best recordings are of popular music. Not that it doesn't merit it, but remembering the high cost of rehearsing a symphony orchestra, I sometimes wonder that the results are not better.

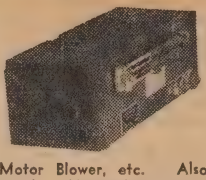
Among this month's releases I picked Meet the Commanders, with Eddie Gray on Columbia 330S7512. There are four numbers on each side, and for a demonstration record I can't imagine anything much better. An absolutely silent surface and high level recording makes the most of brilliant arrangements and wide range recording.

And Festival have done all right with Four Hits—Shake Rattle and Roll, Mambo Baby, Hold My Hand and Susan Slept Here. This is a 45 disc cut and processed at the factory in Sydney and the technical boys can take full marks for it. Festival will do well if they keep up this standard.

Then for good measure, Mercury whale in with a couple of 78's which have brought happy smiles to the hit sessions for their good sound. They are Buck Dance, played by David Carroll and Orchestra on A-1121 (Stomp and Whistle on the Reverse), and The Breeze and I by the same orchestra with Vic Damone in the vocal, (backed with To Love You). The number of this one is A1103.

One from the Clef series which impressed me as much for its music as for its recording was by Charlie Parker and his Big Band—five numbers including Temptation, Dancing in the Dark, Night and Day and What is this thing called Love. Charlie Parker is quite a saxophonist—and he plays with arrangements more or less on the symphonic side. Many are brilliant and some are sweet. The recording isn't up to the Columbia, but it's good and different.

AMERICAN RADAR TRANSMITTER TYPE ASB



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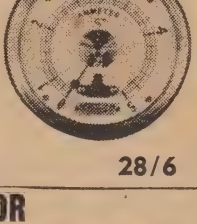

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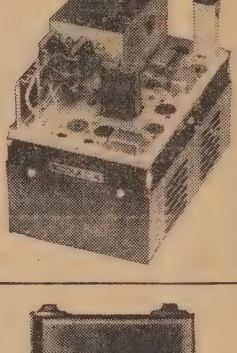

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BINAURAL RECORDS HAVE LIMITS

While in Melbourne a few weeks ago, I had the opportunity of hearing a demonstration of binaural records about which Discobolus waxed rather enthusiastic in the January issue. These records, you will remember, have two tracks recorded from microphones placed some distance apart, and are played with a dual pick-up head through two separate amplifiers.

WHEN the speakers are placed at the correct distance apart, these records give a most impressive aural effect, which has been incorrectly called binaural.

The term is incorrect, because it only applies to a system in which microphones are placed in positions equivalent to a pair of human ears and when played back are heard on a pair of headphones, which prevent any overhearing of sound from one reproducer by the other.

After experimenting with the set-up for some time, several conclusions formed themselves in my mind.

The first was that the placement of the two speakers is very critical. If they are too far apart, there is an immediate impression of a "hole in the middle" which spoils the illusion of the final results.

It is quite surprising to hear a sound originating from one speaker, and a split second later to hear the same coming from the other. Maybe, that's an indication that the idea works, but there is nothing realistic or natural about it.

But when the speakers were placed closer together—and a foot seems to be enough—the gap between them is closed, and their combination is quite good.

But, after analysing my reactions over a time, I was inclined to think that the main value lay in the removal of the point-source effect which is associated with a single speaker. The idea that the sound was emanating from an area rather than from two spots was quite convincing. It was fascinating, too, to hear voices and instruments make themselves heard first at one side of the system and a moment later at the other.

ALTERNATING

But, except for this effect of movement, I doubt whether the demonstration would be substantially an improvement on the idea which was the set scheme of my own about 15 years ago.

It consisted in using multiple speakers—three in all—a bass, middle and high. These were spread out over a distance of about 12 feet, with all the bass came from one set, the middles in the middle, and the highs from the other.

Strange to say there was no noticeable effect of artificiality in the sound, which was particularly good for orchestral and chamber music. Where the players were stationary.

Even voices tended to separate themselves from the accompaniment. Though with some records the frequency division wasn't as effective as with others.

But the system gave much the true illusion of depth to a degree that I got with the binaural records, though it is hard to hazard a guess as to relative merits. The binaural system certainly should do the job rather better than the frequency division method.

But remembering the cost of preparing and playing back the special records, as against the simplicity of the single channel, it may be that you can get a good deal of the "binaural" advantages from standard records. Unfortunately we were not able to arrange things for a comparison.

LISTENING AREA

My second impression was that it is necessary to aim the speakers correctly so that they cover the area in which the listeners will sit. Moving out of this area immediately degrades the effect, and going into the next room as might be expected ruins everything. Although the demonstration room was almost empty, the inclusion of furniture, and the break-up of reflecting surfaces could be expected to call for changes in speaker placement and relative angles.

All these are things one might anticipate, and their observation could hardly bring surprises.

What did surprise me to some extent was that, the more realistic the effect produced, the less "real" it sounded.

What I mean is that, as one began to achieve a spatial effect, and to some extent a sense of depth, the more incongruous it seemed to have an orchestra playing in a lounge room.

I doubt whether this impression would exist for small groups which we might expect to see in a room. But it high-lighted for me my belief that trying to imitate large dimensional performances in the average home is something of a fallacy.

Let me say again that reproduced music is something we have arranged to exist in its own right as a new means of hearing music. I am inclined to the view that there is a limit beyond which we will begin to lose the character of reproduction in a vain attempt to imitate something that can't be imitated.

Assuming a very large room, of course, my remarks would begin to lose their effect. But I believe that the full impact of multi-channel reproduction demands a listening room large enough to preserve some kind of acoustical proportion, just as we now must adjust acceptable volume levels to suit the characteristics of the listening room.

This I feel will limit the future of binaural techniques, and may even lead to the use of more channels or at least more speakers to support realism. It has more the makings of a very specialised type of listening, and the growth of available records, and of binaural tapes, will, I am sure, give rise to some most interesting and profitable experiment.

RECORD NEWS FROM ABROAD

ews this month comes mostly from America where record production d competition continue high. It's interesting to see the name of scha Elman, famous in other days, re-appearing on Decca label.

By DISCOBOLUS

JEW major work from a famous contemporary composer is al- quite an event in musical es, and it can be taken for grant- hat if the work is at all well ved recorded versions will ap- very soon after the publication ie score.

very good instance of this has witnessed in America over the few months, the occasion being announcement of a new sym- y by Shostakovitch, his Tenth. symphony was completed just a year ago, and the first re- on records came from the ert Hall Society last November, ring the Leningrad Philharmonic estra and the conductor, ne Mravinsky, who together the work its world premiere. his time, however, Mitropoulos the New York Philharmonic performed the symphony in rica, and within a few weeks mbia issued the work under artists.

SIAN MUSIC

ncert Hall assert that their re- is the only authorised one, ever that may mean, and the n becomes even more doubtful that the Colosseum Company ch concentrates on selling discs with the tapes received direct Russia) has for sale a further ding, by a Russian symphony estra conducted by none other Shostakovitch himself. A long —it plays for a shade under 50 utes—it does not seem destined clipse in popularity his Fifth phony, which is now available ive recorded versions, three of with American orchestras.

iglish Decca now have made an ption to their apparent policy ecording all of their material in around Europe, with an Ameri- issue of two discs containing whole of an actual recital in egie Hall some months ago by elm Backhaus, when he played Beethoven Sonatas, and works Schubert, Liszt, Schumann, and ms. The presumption being that recording was done by Ameri- it would be interesting to ob- the discs simply to see whether sound is still "Decca's". I have seen the records listed for re- in England, but I may have ed it.

IAN RECORDS

ne first of a series of record- for Decca is the Tchaikovsky in Concerto by Mischa Elman. it else he will play for Decca o not know. This particular ormance is far ahead of the ier release by Ricci and Sir Mal- Sargent on Decca, but I can- imagine them setting Elman off nst Campoli, for instance, in rtos which the latter has made successfully for Decca.

ill in the American scene, West- ster seldom let a month go by out numerous new items. Their st include six overtures by Beet- hoven, with Scherchen and the Vienna Orchestra, two Quartets by Dvorak, and an orchestral version of Bach's Art of the Fugue. All this, plus four Concertos of Vivaldi, ten Handel flute sonatas, two Haydn Quartets from his Opus 76 (there are already two complete sets of Op. 76, and it now seems that Westminster are about to add another), and two Suites by Bach for the Cello, Nos. 1 and 6. Westminster have already released Nos. 2 and 3, so no doubt the others will be along shortly.

One of these days someone will set down just how many of these complete series exist on records in America, and I am certain that the list would be surprising. Walter Gieseking has finished the solo piano works of Mozart for HMV on eleven 12in LP's, and Lili Kraus is about to start on a similar project while Westminster have signed up Fernando Valenti to record all the sonatas by Scarlatti. As Scarlatti wrote over five hundred of these, Mr. Valenti will probably finish knowing quite a lot about him—on something like 40 LPs. Haydn, nevertheless, is still the favorite "packaged-composer", with Bach and Beethoven close behind.

BACH CONCERTOS

Columbia have now deleted a set of Bach's Brandenburg Concertos, played by Fritz Reiner and a Chamber Orchestra, but this is no great loss, as there also exist four other complete sets of these, and Columbia have as a replacement the performance by Casals and the Prades Festival Orchestra. The Casals recording mentioned last month (the Schumann Cello Concerto) has not been well reviewed in America—and with respect to Columbia it appears that it is not, as they have advertised, his first concerto recording in 15 years, as he made a recording for HMV in England nine years ago, on 78's.

On the cheap Camden label, RCA have an album of six LP's, containing all six Symphonies of Tchaikovsky, for less than the price of two ordinary LP's. All are 78 dubbings, hence the low price, but if this sort of thing continues, as it will, it will make available classical music to the people who cannot afford the more expensive playback equipment, which in itself calls for the higher priced records if the sound is to be acceptable.

And lastly, a new idea from the Book-of-the-Month Club. They now have a Music Appreciation Records Branch, selling a 12in record each month, with the music on one side in its complete form, and an illustrated musical analysis on the other. The analysis is also obtainable separately on a 10in disc for those who already have a record of the music itself. I would not care to spend very much money on this, but public libraries would probably find a steady demand for them on a loan basis, and I commend the scheme to them.

SHORT-WAVE NOTES BY ART CUSHEN

SESSION TO ASSIST INTERNATIONAL RED CROSS

The Swiss Shortwave Service has inaugurated a new request programme entitled "A Penny—a Song". This programme works for the international Red Cross through listeners' requests.

HERE is its simple formula: Your request; in order to be valid, must be accompanied by a receipt for a donation to your national Red Cross organisation or by a donation to the International Red Cross in Geneva. In the latter case, A Penny—A Song, will accept and forward unused stamps, money orders, postal cheques, IRCs, and any other forms of authorised international payments . . . but no coins or banknotes. The amount of your donation is left entirely up to you. In its turn, A Penny—A Song, will bring its listeners their choice in music plus new and interesting recordings from the world's popular music repertoire. Finally, each program will include a 15 minute feature show on which many well-known recording artists have already promised to appear as guests.

The session is aired at the following times: Mondays (beamed to Eastern Australia and N.Z.) at 6.0 pm over HER5 (11865, HER6 (15305), HE15 (11715); at 11.30 pm (to South East Asia and Japan) HER5 (11865), HER6 (15305) HEU3 (9665). On Tuesdays (to South Africa, India and Pakistan) at 1.30 am over HE15 (11715), HER5 (11865), HEU3 (9665); at 3.30 am (to the Middle East) over HER5 and HEU3.

Another new feature "Do You Know This?" is listed for every other Monday, and is a quiz game played by Anglo-American and Swiss quiz teams, conducted by Quiz Lance Tschannen. The program appears in several transmissions.

Letter from Holland

A LETTER to its regular listeners from Radio Netherlands says "Hello again" now that the season for better shortwave reception is coming around, and invites them to listen to "The Happy Station" at Hilversum, in Holland. This program feature, now striding into its 27th year of round-the-world broadcasting, is on the air every Sunday at the unaltered time of 8.30 pm to 10.0 pm on 17775kcs, 15425kcs and 15220kcs.

The station is also offering a new illustrated folder "Improving Shortwave Reception," prepared by its technical staff for the erection of various kinds of shortwave antennae. The station's full broadcasting schedule and illustrated literature on Holland is likewise available for the asking. In other words, the station urges, "Keep in touch with the Dutch."

FAMOUS STATION

THE world's most famous missionary station, HCJB "Heralding Christ Jesus' Blessings," from Quito, Ecuador, the city on the equator, in verifying has sent an interesting letter on its new location at Pifo.

"The month of August this year (1954) marked the first year of broadcasting from Pifo, a small town about 12 miles east of Quito. Here we have located five of our six transmitters with their associated equipment. On these 50 acres we have our diesel plant capable of some 400 kilowatts of electrical power, a transmitter house sufficient for present and proposed equipment, high-grain curtain antennae, plus homes for both missionary and national workers. We have one set of bi-directional antennas for North and South America and another set of uni-directional, reversible antennae for Europe and the South Pacific.

"Our present equipment comprises one kilowatt and one ten kilowatt transmitter. The ten-kilowatt transmitter work on the frequencies of 650kc (4[illegible] 9745kc (31m), 15115kc (19m). The one-kilowatt transmitter works on frequency of 700kc in the local broadcast band.

"In Quito we have four studios [illegible] three control rooms. Contact with transmitters in Pifo is carried out thr[illegible] a frequency modulation link. We transmit two programs simultaneously also maintain voice contact 24 hou[illegible] day."

NEWS FLASHES

THE Broadcasting Corporation of C[illegible] operates from the island of Tai[illegible] with these shortwave transmitters: B[illegible] (6095) Taipei, 3.5kw., 12.30-4.0 pm, 9.0 ah, and 11.30-5.30 pm. BED7 (7[illegible] Taipei, 20kw., 11.50 am-12.20 pm, 1[illegible] 3.30, and 5.0-5.30 pm BED6 (11736) Ta[illegible] 50kw. 5.0-8.0 am, 9.30-11.0 am, 11.50 [illegible] 5.30 pm. BED4 (11920) Taipei, 20kw., [illegible] mid-12.30am, 5.0-8.0 am, 9.30-11.0 am. [illegible] lish news is given over BED4 and B[illegible] from 3.5 pm to 3.30 pm and 7.30 pm [illegible] 8.5 pm.

CANADA.—CBU of the Dominion [illegible] servatory, Ottawa, Ont., is radia[illegible] continuous time signals on 3330kcs, [illegible] watts: 7335kcs, 3000 watts: and 146[illegible] 300 watts.

MOZAMBIQUE—"Radio Pax" is a [illegible] missionary station at Beira with the sl[illegible] of "Emissora Catholica de Beira." [illegible] operates on 3120kcs and 7205kcs.

ANGOLA.—"Radio Clube de Huam[illegible] Caixa Postal No. 125, Nova Lisboa, [illegible] the air till 7.0 am sign-off on 1193[illegible] Portuguese language.

HOUMANIA.—Radio Bucharest has [illegible] English session to North America [illegible] 1.0 to 1.30 pm and again from 2.3[illegible] 3.0 pm. The frequencies in use are 957 [illegible] and 6210kcs. To Britain at 5.30 to 6.0 [illegible] on 9570kcs, 9254kcs and 6210kcs, and [illegible] 8.30 to 9.0 am on 9570kcs and 6210kcs.

LATEST LIST OF BBC WAVE-BANDS

Band	Metres	kc/s	Call Sign
	75.47	3975	GRC
49	49.92	6010	GRB
	49.71	6035	GWS
	49.67	6040	GSY
	49.59	6050	GSA
	49.50	6060	[illegible] X
	49.42	6070	[illegible] R
	49.26	6090	[illegible] M
	49.10	6110	GSL
	48.98	6125	GWA
	48.78	6150	GRW
	48.66	6165	GWK
	48.62	6170	GSZ
	48.54	6180	GRO
	48.43	6195	GRN
41	42.19	7110	MQS
	42.13	7120	GRM
	42.05	7135	GRS
	41.96	7150	GRT
	41.75	7185	GRK
	41.67	7200	GWZ
	41.61	7210	GWL
	41.49	7230	GSW
	41.38	7250	GWI
	41.32	7260	GSU
	41.21	7280	GWN
	40.96	7325	GRJ
31	31.88	9410	GRI
	31.55	9510	GSB
	31.50	9525	GWJ
	31.41	9550	GWB
	31.35	9570	GWX
	31.31	9580	GSC
	31.25	9600	GRY
	31.17	9625	GWO
	31.12	9640	GVZ
	31.06	9660	GWP
	31.01	9675	GWT
	30.96	9690	GRX
	30.93	9700	GWY
	30.82	9735	GWF
	30.74	9760	MCR
	30.71	9770	MCN
	30.53	9825	GRH
	30.26	9915	GRU
25	25.68	11680	GRG
	25.64	11700	GVW
	25.58	11730	GVV
	25.53	11750	GSD
	25.49	11770	GVU
	25.45	11790	GWV
	25.42	11800	GWH
	25.38	11820	GSN
	25.34	11840	GWQ
	25.30	11860	GSE
	25.25	11880	GRE
	25.23	11890	GWW
	25.19	11910	MCO
	25.15	11930	GVX
	25.12	11945	MCQ
	25.09	11955	GVY
	25.08	11960	MCT
	24.92	12040	GRV
	24.80	12095	GRF
19	19.91	15070	GWC
	19.85	15110	GWG
	19.82	15140	GSF
	19.76	15180	GSO
	19.72	15210	GWU
	19.70	15230	GWD
	19.66	15260	GSI
	19.61	15300	GWR
	19.60	15310	GSP
	19.44	15435	GWE
	19.42	15447.5	GRD
16	16.95	17700	GVP
	16.93	17715	GRA
	16.92	17730	GVQ
	16.91	17740	GRQ
	16.86	17790	GSG
	16.84	17810	GSV
	16.79	17870	GRP
	16.77	17890	GVO
13	13.97	21470	GSH
	13.93	21530	GSJ
	13.92	21550	GST
	13.87	21630	GVT
	13.86	21640	GRZ
	13.84	21675	GVR
	13.82	21710	GVS
11	11.66	25720	GSR
	11.65	25750	GSQ
	11.61	25840	GSS
	11.50	26080	GSK

THE HAM BANDS WITH BILL MOORE

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gola: L.A.R.A., PO Box 152, Luanda.
gentina: R.C.A., Avenida Libertador
ral San Martin 1850, Buenos Aires.
stria: DVSV, Kierlingerstrasse 10,
erneuberg.
stria: QSL Bureau (US Occupation
rs), APO 168, c/o Postmaster, New
, NY, USA.
ores: Via Portugal.
hamas: C.N. Albury, Telecommuni-
ns Department, Nassau.
bados: VP6PX, Wood Goddard,
ley, Welches, Christ Ch., Barbados,
sh West Indies.
gian Congo: PO Box 271, Leopold-
lgium: UBA, Post Box 634, Brussels.
rmuda: VP9D, James A. Mann, The
St. Georges.
livia: RCB, Casilla 2111, La Paz.
azil: LABRE, Caixa Postal 2353, Rio
aneiro.
itish Guiana: Desmond Young, 22
ex St., Charlestown.
tish Honduras: D. Hunter, Box 178,
e.
lgaria: Box 830, Sofia.
rma: BARS, PO Box 376, Rangoon.
nada: See separate list.
nton Island: H. B. Johnson, KB6BA,
SO, 06-50,000, Canton Island, South
ic.
ylon: PO Box 907, Colombo.
ile: Radio Club de Chile, Box 761,
iago.
ina: M. T. Young, PO Box 16, Tai-
g, Formosa.
lombia: LCRA, PO Box 584, Bogota.
ok Islands: Ray Holloway, PO Box
Rarotonga.
sta Rica: Radio Club of Costa Rica,
Box 535, San Jose.
ba: Radio Club de Cuba, QSL
au, Lealtad No. 660, Havana.
prus: Mrs. E. Barrett, Box 219,
ssol.
echoslovakia: C.A.V., PO Box 69,
ue, 1.
nmark: P. Heinemann, OZ4H, Van-
s Alle 100, Copenhagen.
minica: Calle Duarte No. 76, C.
illic.
st Africa (VQ1, VK3, VQ4, VQ5):
Box 1313, Nairobi, Kenya Colony.
uador: Guayaquil Radio Club, Casilla
Guayaquil.
I.R.T.S. QSL Bureau, c/o EI5Z,
Orwell Gardens, Rathgar, Eire.
ji: S. H. Mayne, VR2AS, Victoria
ide, Suva.
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ance: REF, BP26, Versailles (S. and
rmany (DL2 calls only): Via Great
ain.
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eau, APO 757, c/o Postmaster, New
k, NY, USA.
rmany (DL5 calls only): Via France.
rmany (other than above): DARC,
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Milne, 29 Kechill Gardens, Hayes,
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York, NY, USA.
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Indonesia: PARI, PO Box 222, Surabaya, Java.
Israel: IARC, PO Box 4099, Tel Aviv.
Italy: ARI, via San Paolo 10, Milano.
Jamaica: Thomas Meyers, 122 Tower St., Kingston.
Japan (JA): JARL, Box 344, Tokio.
Japan (KA): FEARL, PO Box 111, APO 500, c/o Postmaster, San Francisco, California, USA.
Kuwait: Doug. Taylor, MP4KAA, Box 54, Kuwait, Persian Gulf.
Lebanon: RAL, BP 1202, Beirut.
Libya: See Tripolitania.
Luxembourg: G. Berger, 40 rue Thevires, Luxembourg.
Macao: Via Hongkong.
Madeira: Via Portugal.
Malaya: QSL Manager, PO Box 600, Penang.
Malta: R. F. Galea, 20 Collegaite St., Birkirkara.
Mauritius: V. de Robillard, Box 155, Port Louis.
Mexico: LMRE, Liverpool 195-A, Mexico, D.F.
Montserrat: VP2MY, Plymouth.
Morocco: AAEM, PO Box 2060, Casablanca.
Morocco (Tangier International Zone only): PO Box 150, Tangier.
Mozambique: Liga dos Radio-Emissores, PO Box 812, Lourenco Marques.
Netherlands: VERON, PO Box 400, Rotterdam.
Netherlands Antilles (Aruba): Post Box 80, San Nicolas, Aruba.
Netherlands Antilles (Curacao): Post Box 383, Willemstad, Curacao.
Netherland East Indies: Hr. C. Loze, PKILZ, Burg. Kuhrweg, 47 Bandoeng, Java.
New Zealand: NZART, Box 489, Wellington, CI.
Nicaragua: L. B. Satres, Bolivar Av, 106 Managua.
Northern Rhodesia: NRARS, PO Box 332, Kitwe.
Norway: NRRL, PO Box 898, Oslo.
Okinawa: OARC, APO 331, c/o Postmaster, San Francisco, California.
Pakistan: Box 2002, Karachi.
Panama Republic of: LPRA, Box 1622, Panama.
Paraguay: RCP, PO Box 512, Asuncion.
Peru: RCP, Box 538, Lima.
Philippine Islands: Elpidio G. de Castro, Philippine Amateur Radio Assn., 2046 Taft Av., Pasay City.
Poland: Polski Zwizek Krotkofalowcow, PO Box 320, Warsaw.
Portugal: REP, Travessa Nova de S. Domingos, 34-1, Lisbon.
Rumania: ARER, PO Box 95, Bucharest.
Salvador: YS10, Apartado 329, San Salvador.
Siam: Thailand: Frank Spier (W6FUV), Saha Thai, 4th Mansion, Raja Damneon Av., Bangkok, Thailand.
Singapore: PO Box 176, Singapore, Malaya.
South Africa: SARL, PO Box 3037, Capetown.
Southern Rhodesia: RSSR, Box 2377, Salisbury.
Spain: URE, PO Box 220, Madrid.
St. Vincent: VP2SA, Kingstown.
Sweden: SSA, Stockholm, 4.
Switzerland: USKA, Post Box 1203, St. Gallen.
Syria: PO Box 35, Damascus.
Trieste: PO Box 301, Trieste, FTT.
Trinidad: John A. Hoford, VP4TT, PO Box 554, Port-of-Spain.
Tripolitania: 5A2TZ, Box 372, Tripoli.
Uraguay: RCU, PO Box 37, Montevideo.
USA: See separate list.
USSR: Central Radio Club, Post Box N-88, Moscow.
Venezuela: RCV, PO Box 2285, Caracas.
Virgin Islands: Richard Spenceley, Box 403, St. Thomas.
Yugoslavia: SRJ, Post Box 48, Belgrade.

Lists covering QSL Bureaus in USA and Canada will be covered next month.

Poor VHF conditions

The propagation conditions experienced right through the two months of the Ross A. Hull Memorial Trophy were poor and January provided no improvement over the previous month. Plenty of stations were active but the openings just did not occur.

The remarkable tally of 500 contacts by VK4NG, of Rockhampton, showed that at least one station had a "Sporadic E Cloud" in the right place for long periods.

Major Collett, VK2RU, of Gosford, who makes a fairly close study of conditions on 50 Mc, decided it was the worst DX season experienced since the peaks of 1947-48. He records time spent listening, openings and stations heard, and so obtains a comparative figure from year to year.

Following the Kosciusko trip in January, the next move of the NSW VHF group will be to check on the northern link to Queensland on the 144 Mc band. At present the general idea will be test transmissions on the band from Mt. Ebor out from Armidale in an endeavor to span the portion of the Sydney-Brisbane not previously covered.

It is intended that Roy Hart, VK2HO, Horry Lapthorne, VK2HL, and possibly others will make the trip in April, to produce the desired signal, and with the co-operation of other 144 Mc enthusiasts, should complete the link between the two capitals.

The trip, it is hoped, will check the link in preparation for an all-out effort to complete a link between Brisbane-Adelaide during the group's Spring Field Day.

The Sydney-Adelaide section of the route was spanned during last year's event. The field day is to be conducted during the first weekend in October.

Incidentally, the whole of the operation at Mt. Kosciusko and Kendall by VK2HO and VK2APQ was recorded on tape and will be presented at the NSW VHF section's meeting.

Radio amateurs on the North Coast of NSW, in view of the possibility of serious flooding in that area on the weekend, January 22 and 23, took precautionary measures and tested equipment and checked channels.

This group of amateurs have in the past provided valuable emergency communication circuits and immediately take necessary action to cover further operation when floods are threatening.

Fortunately on this occasion river levels dropped before serious flooding occurred.

URUNGA COVENTION

The program for the North Coast and Tablelands WIA Zone Convention to be held at Urunga on April 9, 10, and 11 has been completed and covers all phases of amateur operation.

The convention receives the full support of civic authorities at Urunga and with their assistance an enjoyable time is ensured for the ladies and children when the OM is busy on his contests and competitions.

Excellent prizes will be available due

(Continued on Page 101)

Hey Fellows!
It's the King of Hobbies

Amateur Radio

Whether your interest runs to DX on the low frequencies; a yarn over the Tasman to New Zealand, V.H.F. with its wide range for experimentation, or any of the many phases of Amateur Radio Communication, the WIRELESS INSTITUTE of AUSTRALIA (N.S.W.) DIVISION'S CLASS is your "open sesame" to a great hobby. (VICTORIAN DIV. CLASS commenced 3/2/55 and in progress.)

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generosity of trade houses and IA disposals section. To compete hese prizes a low-power portable itter and receiver covering the 7 nd and a 144 receiver and beam that is required. These will cover ld events.

ou have no suitable equipment on you can still go into the field with competitors.

ommodation officer for the conven- s Ted Gabriel, VK2AVG, c/o Post Urunga, and inquiries should be ded as above. Camping facilities so available at the camping ground e, as is also dormitory shelter with and electric light.

HAMFEST

annual Hamfest of the NSW Divi- of the WIA was held in Sydney the Australia Day weekend in ry.

three sessions, monthly meeting e Friday evening, technical and Saturday afternoon and evening, usiness on the Sunday morning, well attended.

umber of country amateurs were it and the session held at the y Showground offices provided ex- t entertainment.

WI was operated from the Show- d on the 3.5 and 7 Mc bands on aturday. Contacts were numbered rizes awarded to amateurs making n QSO's. The latter idea provided interest for members who could ttend the convention.

NTEST PUBLICITY

latest method of publicising DX sts, that of sending rules to last competitors, is a good move. It es that interested amateurs know st dates and rules.

mally the overseas journals cover- hese contests arrive in Australia the contest is over. Both the and RSGB sent printed copies of for their contest this year.

ort for DX contests has fallen off cent years and publicity is an im- factor to ensure the old stal- will operate each year.

CW enthusiasts seem to appre- contests more than the Phone gang. ps an improvement in conditions ee some revivals in interests.

second weekend of both the CW Phone sections of the ARRL's 21st national DX Competition will be ucted during March. The Phone n commences 2400 hrs GMT, on h 11, and concludes at 2400 hrs on March 13; the CW section runs en the same times on March 25 arch 27.

changed serial numbers for W/VE nts should assist amateurs in other ries who are requiring States for a

VE amateurs are using for the time a serial number indicating the in which they are located.

RSEAS NEWS

ARRL is making a concerted effort ncrease the number of amateurs ting on the 50 Mc/s band and have sted that the FCC permit Tech- Class Licencees to operate on that . Previously the league had sug- d the band be opened for Novice tion.

FCC refused the latter request hey considered that Novice Class cees were not qualified technically al with likely cases of TVI.

has been noted in the US that ancy of the 50 Mc/s band has in recent years, and there has a large influx of stations to 144

umber of Technical Class Licencees after obtaining their General Class ce (permitting operation on all s), remain on the 144 Mc band. a long-range policy the league will er press for Technical Class opera- on 50 Mc/s.

s will not only increase occupation also provide further information on gation techniques at that fre- cy.

Old Old Timers' Club in the US ged the FCC to remove single band operation from the normal hony allocations as they consider wo modes are incompatible.

idea had some support from in- dividual amateurs who considered that further development of SSB would be assisted if separate allocations were made for this type of emission.

The petition was finally dismissed by the FCC.

The commission considered that both types of transmission could be operated together and furthermore it was not their policy to increase the number of sub-bands within amateur allocations.

The 3.5 Mc band during January provided excellent conditions from Eastern Australia to the US. Static reached terrific levels at times, but many good CW contacts were made.

VK amateurs would like to enjoy the conditions that prevail in New Zealand where static levels are reasonable during summer months. Unfortunately, DX here is at its best during the period of high QRN levels.

Recently a ZL expressed the opinion that 70 pc of amateur activity was carried out on the 3.5 Mc band, while here during the summer months operation would be restricted to only a few per cent.

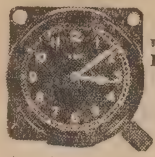
In NZ it must be remembered that all new amateurs spend their first 12 months on this band before they can qualify for a high frequency permit. This factor would affect the occupancy of the band.

A point that causes some concern to VK 3.5 Mc DX enthusiasts is the answering of CQ DX calls by NZ amateurs.

It is appreciated over here that ZL newcomers are naturally anxious to contact VK stations, but the habit of replying to such calls causes much interference to the weak DX stations.

There is an understanding that VK's do not answer DX calls from ZL stations on HF bands and vice versa. The same should be applied to the 3.5 band.

LUCKY REPURCHASE ENGLISH SMITH 8 DAY CLOCKS



As used by the RAF.

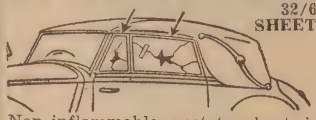
Luminous Dial.

£5/15/-

Fitted with Sweep Second Hand. Ideal for any car or truck.

Replace those broken side curtains with cellulose acetate which takes the place of celluloid and lasts four times longer. Will not discolor.

32/6 SHEET



Non-inflammable acetate sheet is recommended for all types of side curtains. Sheets are 20 thousandths of 1 inch thick. Size of sheet, 24in x 52in. Can be sewn or cemented into frames.

Now you can make your own music box with these Swiss music units. They can be fitted to any type of box, doll, jug, teddy bears, etc. Hours of enjoyment for all the family.

30/-

EACH

Tunes available, Lili Marlene, Jingle Bells, Blue Danube, Harry Lime Theme, Wedding March, The Merry Widow, Happy Birthday, Annie Laurie, How Dry We Are, Roll Out The Barrel, Silent Night, Teddy Bears' Picnic. Also available a few only double units which play 2 tunes, 50/- each.

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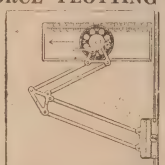

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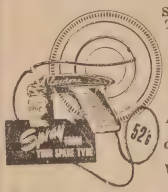
25/- Complete

Complete with Drawing Arm



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Weston 0-50 volt 0-100 amps combined M/coil, £3/10/-

English 50-0-50 Ammeters, M/coil 37/6
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IDEAL FOR WHEELBARROWS, HAND TRUCKS, TRAILERS, etc.

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10½in x 4½in, £4/15/-, complete with tube.

English Motor and Blower, 24 volts. Will work off any Lighting Plant.

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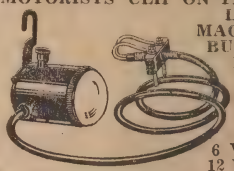

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Complete with flex and plug.

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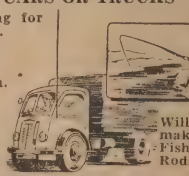

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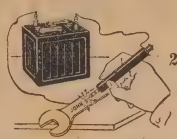

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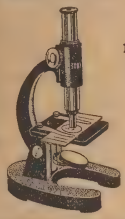

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slide included in nice box.

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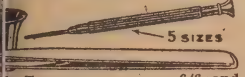

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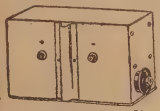

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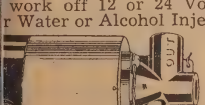

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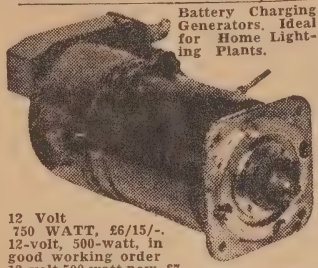

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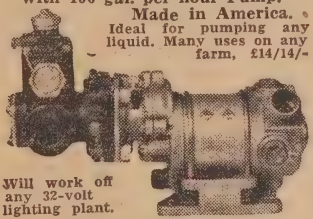
Ideal for pumping any liquid. Many uses on any farm, £14/14/-



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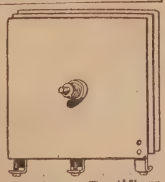

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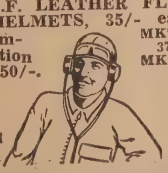
Intercommunication Tubes 50/-.



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BALL AND SOCKET INSPECTION MIRRORS

8/9

Ideal for mechanics, radio repairs.

SOME HINTS ABOUT SOLDERING

No beginner can go very far in radio, these days, without learning the simple but importa art of soldering. Read this article, then try your hand at it. Only practice can make perfec

By Mervyn Haddleston

IN gaining this practice, you don't have to work on an actual radio set. Apart from the soldering kit, all you really need are a few scraps of copper wire and metal of the type used in radio—brass, coppper, nickel plate and tinplate.

When you have learned to solder these together, you can then practise soldering radio type "hook-up" wire to a couple of valve sockets, without charring the insulation or otherwise making a mess.

After that, you'll be able to tackle the soldering in radio sets without any worries. And good soldered joints are important.

If we consider the number of such joints in a modern radio receiver, one can imagine the amount of time spent in tracing down even one faulty connection.

What makes it hard is that connections don't have to be falling apart before they can be classed as "faulty". A blob of solder can sit on a wire and a valve socket lug without actually adhering to them.

It might even allow the passage of current, as measured on a test meter. But, slight movement of the wire, due to vibration, &c., may easily produce an intermittent contact between the two surfaces, resulting in noise through the speaker or phones.

The only sure way to avoid such trouble is to take care, being quite sure of each joint before passing on to make the next one.

To ensure good soldered joints, there are three prime requirements:

(1) Enough heat (but not excessive) to flow the solder on to the metal.

(2) Clean metal surfaces and a clean, properly tinned iron.

(3) A suitable "flux".

EFFECT OF FLUX

The flux serves two purposes. It forms an airtight film over the flowing solder and retards or prevents oxidisation of the heated metal surfaces. It may also have a purging effect on the surfaces, combating thin films of grease or oxide.

Resin is very suitable as a flux for radio work, provided the surfaces to be soldered are new and clean. It is often included as a core in what is known as "resin-cored" solder. When such solder is applied to the heated surfaces, the resin flows out as the solder melts, providing a ready-to-hand non-corrosive flux.

With new components, a whole receiver may often be wired, relying only on the flux qualities of the resin.

Difficulty arises, however, where the surfaces are contaminated, because the resin cannot neutralise their effect.

Household plumbers, who often have to meet such situations, simply use zinc chloride ("killed spirits"), which is a powerful cleaning agent as well as a flux. However, this technique must not in any circumstances be used for radio work, because the spirits are highly corrosive and continue to attack any surfaces which may have been exposed to them.

SOLDERING PASTES

In between these two extremes are a variety of manufactured soldering pastes, many of which are excellent for radio work.

However, to prevent possible corrosion taking place after using such flux pastes, it is advisable to remove the residual flux after soldering. This can be done by wiping the finished joint with a piece of clean rag dipped in methylated spirits.

Solder is an alloy of lead and tin. Different grades are obtainable from a coarse type—75 pc lead 25 pc tin—to 20 pc lead and tin, the former requiring a gr amount of heat in melting.

The solder usually obtained the radio stores is a 40 pc lead 60 pc tin combination and is sidered the most satisfactory for ordinary radio work.

The third essential item of equipment necessary for solderi the iron.

With the advent of the ele iron, soldering became a much convenient operation, although quiring an appropriate supply age—depending on the type of —with a power point near the on hand.

An electric soldering iron m the job much easier, because it m tains an even temperature, right to flow the solder.

An electric iron is not esse and the beginner can get by sonably with a simple iron he over a gas ring or a spirit s Irons of this type are sold c cheaply by chain stores.

In using them, the main prob is to rest them somewhere the flame where they will rer hot without running to red hea

An iron which is too hot not solder properly, for reasons shall explain in a moment. It ca the flux to spatter over nearby faces and may char bakelite other insulating materials close the joint.

The tip of the iron in each consists of copper, which is a good conductor of heat. Howe copper when heated, as with m metals, forms an oxidised coa on its surface which resists the tra fer of heat.

To overcome this it is neces to "tin" the tip before using

ELECTRIC IRONS

In the case of the gas-heated i it is only necessary to plunge heated iron tip into a tin cont ing scraps of solder and sal moniac.

Pre-cleaning of the copper tip not essential, but it is necessary raise the temperature of the to nearly "red hot" to ensure it takes full advantage of the cle ing characteristic of the salammon

For this reason the method is u less for the ordinary electric and, for other obvious reasons, i not advisable either with the ty of "quick-heating" electric irons.

In the case of the slow-heat electric iron, the procedure is heat the iron and file one clean then, before the copper ox ises, as indicated by discoloring, this cleaned surface on a piece tin feeding it with resin-flux solder.

Treat the other faces in the sa manner until the point of the is completely covered with sol wiping with a cloth to remove excess flux.

Since the quick-heating iron quires the appropriate heating te perature in a very short time, in

the tip may be cleaned before
ıg. However, should the tin-
prove difficult, the solder not
ıg" to the copper, a more active
ng flux, such as a flux paste,
be used.
practice a smear of such paste
handy addition to the resin in
ıg to effect the more difficult
But it should be used very
igly, making sure that all the
ıal flux is removed after sol-
g.
ore attempting to solder a joint,
all the surfaces thoroughly.
in mind that even the small
nt of grease from the hand, if
ed to remain on the joint, will
times resist the flow of solder.
t surfaces are effectively scraped
with the edge of a screw-
r, a knife or a razor blade,
eas wires can be rubbed over
a piece of emery cloth. This
e best way also to remove the
el from the surface of enamelled
as used in coils and transform-

ING THE JOINT

ıen satisfied that the surfaces
clean, place the tip of the hot
on the joint and allow all the
to attain a temperature capable
ısily melting the solder. Apply
lux and solder—to the job, NOT
iron—still holding the iron
ɔsition, until the solder "takes"
flows into all the crevices of
connection.
ating the joint before feeding it
solder is an important point,
unless carried out will often re-
in the solder just sitting on
oint in an unattractive "blob".
ıy constructors have the idea
the more solder used, the
ger will be the connection. This
ot necessarily so. Flow just
gh solder on to each joint to
a smooth and nicely-rounded
smoothly merging into the sol-
i surfaces.
lder which may happen to run
rneath a joint can generally be
d away after with the hot tip
ıe iron.
the solder just sits as a blob
ɔp of the surfaces without merg-
into them, there is every rea-
to suspect a "dry" joint, which
break easily.

RT AGAIN

ould the solder completely come
from one of the surfaces it
be necessary to re-clean that
ıce and start again. This time
ɔy the aid of a paste flux.
nally as a word of warning. Do
allow any of the parts being
d to move while the solder is
ifying as this is one sure way
nishing up with a weak joint.
you anticiapte that a soldered
will have to take a lot of strain
se, it is a good idea to make a
ıanical joint first before apply-
the solder. Thus, a wire may
ɔoped through the hole in a
bent over and then soldered.
strength of such a joint is likely
e much better than one relying
he solder only.

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he smallest book printed with able type was published in and is entitled Galileo a lama Cristina di Lorean. It 205 pages, but measures only -half by three-quarters of an

A READER BUILT IT

(Continued from Page 84)

put of the rectifier; it will be approximately twice that from the centre-tap of the transformer, i.e., approximately equal to the value of the whole voltage across the transformer winding.

The circuit arrangement of fig. 3 is known as a voltage doubler, since the output from this circuit is approximately twice that obtained from the winding of the transformer.

Where a low-voltage secondary of a transformer is used, this arrangement is convenient as it allows the motor or model to operate from a supply a little above its normal rating, and hence also compensates for a voltage drop in the rectifier elements when the current is being drawn.

The two condensers or capacitors (same thing) are necessary in this circuit to assist the doubling action. When the voltage at the top of the transformer winding—looking at it as it is drawn—is positive, it charges the top capacitor to the full value via the rectifier element connected to it.

When the voltage reverses—since it is alternating current at the transformer secondary, the charge on this top capacitor flows through the motor or other device and tends to return to the now negativve side of the transformer, i.e., the top again.

Meanwhile, the bottom capacitor receives a charge also, and the effect is to have the two full voltages of the capacitors in series, and providing a total of twice the input voltage to each.

Note that in the case of the circuits of fig. 1 and 2 also, best results are obtained if a filter capacitor is connected across the output of the rectifiers.

BOOK REVIEW

(Continued from page 65)

RADIO AND TV TEST INSTRUMENTS. Published by Gernsback Publications; Gernsback Library No. 49. Stiff paper cover, 128 pages.

In the introduction to this book, the publishers point out that many enthusiasts like to build their own test gear, not only for economic reasons but because it allows them to acquire just the items they need and the ability to service them should anything go wrong.

In keeping with this, the publishers have grouped together a number of instruments and gadgets which have been described from time to time in Radio-Electronics magazine.

The instruments include a grid-dip and absorption meter, a small oscilloscope, an oscillator, a signal tracer and one or two others. The "gadgets" include devices to facilitate picture-tube testing, a "signal-launcher", a power tester, &c.

There is a design included for a home-service carrying case and a radio test bench.

Though the instruments are all designed around American parts, local constructors should be able to make use of the basic ideas and substitute locally available components.

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These indicator units contain the following valves:-

Six 6SN7GT, one 6G6, one 6H6, one 6X5GT, one 2X2 and 3BP1 C.R.O. tube which is fitted in a separate shield on a 4ft shielded lead and supplied with control box and plug; case and shield are finished in black brocade. In original cartons.

TRANSFORMER TO CONVERT THIS UNIT FOR 240 VOLT OPERATION AVAILABLE AT £3/15/- EXTRA plus postage.

£8/15/- F.O.R.

NEW 5 VALVE D.W. BATTERY CHASSIS

This D.W. battery mantle chassis which is made by leading manufacturer is fitted with heavy duty Rola 6in speaker, tone control etc. and gives excellent reception on local, interstate and overseas stations. Ideal for building in to existing furniture, boats, caravans etc. Valves used—two 1T4, one 1R5, one 1S5, one 3V4.

re £8/15/- **Now £5/17/-**

EW VALVES CAN BE SUPPLIED AT £3/10/- EXTRA AND BATTERIES £1/17/- EXTRA

stage and packing on chassis extra NSW 15/ interstate £1/2/- on batteries NSW 6/-

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Used but in good order,

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LORAN-CATHODE RAY-INDICATORS

ese indicators contain the fol- ving valves—one 5CP1 with eld 14 6SN7, 8 6H6, 3 6L7 and 1 6SJ7.

Were £15/-/-

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CONDENSER SPECIAL

merican Dubilier oil filled paper ndensers. 15 M.F.D.—600 Volt

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Geared rotatable loop suitable for adapting to light beam rotators, supplied with 30in flexible drive.

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These small motors measuring 3½in x 3in are suitable for models etc. Fully laminated and fitted with ball bearing with rubber coupling. 1,800 rpm.

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Protect your equipment with these mounts. Set of 4 mounts and rack. 11in by 8in.

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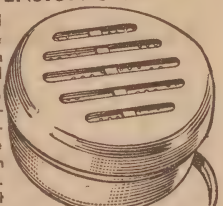

It's a real miniature with Rola unit. Install it anywhere, in the sick-room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLOFONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3½in Diameter by 1¾in deep.

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7" Dynamic speakers by leading manufacturer, 1,500 ohm Field coil, 7,000 ohm Transformer

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Teletron Standard Octal Sockets (moulded bakelite)

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Nine pin loctal sockets moulded

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Six pin wafer sockets, 2/6doz

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12mfd 525 V	4/6 NOW	**3/9**
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Heavy duty 12in per-mag speaker by well-known manufacturer. 10T. C.T. or 5,000 Transformer

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807	£1/0/0	**15/0**
100TH	£3/0/0	**£2/0/0**
803	£3/0/0	**£2/0/0**
837	£2/0/0	**£1/10/0**
1616	£2/0/0	**£1/10/0**

RECEIVING VALVES

	Old Price	New Price
6SA7	12/6	9/9
6SQ7	12/6	9/9
12H6	12/6	9/9
1C7G	11/6	9/0
1K7G	10/6	8/6
6K8G	15/0	10/0
6AG7	12/6	9/9
12S.R.7	12/6	6/6
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6V.6G.	15/-	10/-
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NEW ENGLISH CONRAD RECORD PLAYERS

Single speed 78 rpm record player fitted with high fidelity Acos pick-up and Auto-stop. Free 3 Rothermel sapphire needles supplied with each player, sufficient for 6000 recordings.

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7/6ea. in dozen lots

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ere £9/17/6 .... **NOW £6/10/-** F.O.R.

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volt genemotor supply containing two nemotors one giving 550 volt at 350 lls and the other 250 volts at 100 mills o contains filter condensers, relays, e holders, etc.
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upling units for A.T.5. Transmitter ntaining two aerial change-over relays, ndensers. meter, etc.
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ese are suitable for car or truck aerials make ideal fishing rods. Contains ree 4ft sections of tapered spring steel. (Cannot be sent per post)
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ese sights contain 4in spirit-filled compass th corrector, two spirit levels, rack and pinion d many useful gears. The unit is mounted in oden case with locks and handle.
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HIGH RESISTANCE HEADPHONES

3,000 ohm. Headphones made by S.T.C. used but in good order.
Were 25/- **NOW 20/-** Plus postage

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Low to high impedance headphone transformers with plug and jack.
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These midget U.H.F. receivers made by Western Electric have a frequency range of 238 to 258 megacycles using one 955 and three 954 Acorn valves (complete with valves).
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New 26 pin shielded plugs and sockets with silver plated contacts.
Were 10/- **NOW 5/- pair,** plus postage
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866	15/-	10/-
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Flexible drives to suit command transmitters or receivers 5ft 6in long.
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These panels are new in wooden boxes and contain 50 volt 100MA Rectifier, sensitive relay, bezel with lamp and holder, phone jacks, etc.
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These streamlined design, precision built cameras in durable plastic, feature precision finished lenses, shoulder strap in matching colour, dual spool adaptor takes 120 or 620 film, finger tip spring return shutter control, direct vision eye level view finder. Takes eight pictures 3½in by 2½in on 620 film.
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PHONE LA6087

ANSWERS TO CORRESPONDENT

G. B. (Panania, NSW) write to enquire whether an amateur's licence is required to operate radio transmitters for the control of models.

A.: A licence from the PMG's department is required for the operation of such transmitters — in fact, for the operation of any transmitters — but this is not an amateur's licence. In fact an amateur's licence does not cover such operation. Full details of the requirements can be obtained from the Radio Inspector, Wireless Branch, GPO, Sydney. Briefly they require that the equipment be capable of remaining within the asigned channel (a description of the equipment must be submitted), be not capable of generating more than two watts in the plate circuit of the final amplifier, and that they must not cause interference with any other channels. Licences are granted on a six monthly basis and the department must be advised whenever experiments are to be carried out.

H. E. D. (Hawthorn, Vic.) inquires about the availability of a neon indicator Z 8 for a MecaBlitz Electronic Flash.

A.: We have no knowledge of a flash unit of that make. We cannot therefore give you any information about suppliers of the above neon indicator. It is likely however, that the neon bulb, as used with our Electronic Flash Unit would be suitable. This can be supplied by Nova Electronic and Engineering Co., of 311 Sussex St., Sydney, and we suggest that you contact them about it.

R. H. (Yurongpilly, Q.) writes to suggest that we describe an ultra midget type of radio, sometimes referred to as pocket radios. He suggests that this might be built around the new transistors and other midget components. He also encloses a circuit of a simple one valve set and wants to know if it could be adapted to this form of operation.

A.: Many thanks for your suggestion R.H. and we have considered something along these lines from time to time. Unfortunately there are a number of problems to be solved if the device is to something more than a novelty having little practical application. It is true that transistors are now being used in hearing aids, but they are not yet available in quantity for the experimenter. Also, as you suggest, they are much more expensive than valves. The expense of the hearing aid batteries must also be considered, plus the fact that these are not so readily available as the more conventional type radio batteries. The mica dielectric tuning capacitors are also rather scarce these days. These points make it rather difficult for us to describe a set which we know that all readers will be able to make without difficulty. The circuit you submit is a fairly straightforward type of Reinartz circuit and we have described several similar sets over the years. It is possible to substitute a loop aerial for the normal aerial coil but this is hardly likely to be satisfactory if its size is in keeping with the ultra midget idea. It would probably be better to retain the conventional Reinartz coil and operate with a short length of wire as an aerial. Alternatively you may care to use a Ferroxcube rod aerial as we did in the Loopstick One (July 1954). The one restriction on the use of these devices is that they must be used horizontally for best results. For the design of loop aerials for regenerative sets we would refer you to the March 1953 issue and the Reinartz Portable.

C. H. (South Perth, WA) sends us his subscription for this year and recounts some experiences he has had in experimenting with different types of loudspeaker baffles. Using a high quality speaker he has tried an infinite baffle, absorption baffle, large vented enclosure and corner enclosure and states that the infinite baffle has proved the most satisfactory. As a matter of fact, his findings substantiate our statements in one of the articles in "Let's Buy An Argument".

D. R. T. (Murupara, NZ) writes that he is looking forward with much interest to every issue of R & H and inquires about the makers of trigger transformers for electronic flash units, and 650 mfd condensers.

The trigger transformers are made by Nova Electrical and Engineering Co. of 311 Sussex St., Sydney. The high capacity condensers are made by TCC and are supplied through United Capacitor Co. Pty. Ltd., of 433 Punchbowl Rd., Enfield, NSW.

J. T. (Lower Hutt, NZ) in his letter J. T. writes that R & H is well worth its price, and also inquires about the ation of a fluorescent light.

The usual variety of fluorescen consists of an evacuated glass tub a certain amount of mercury vapor afterward. Each end of the tube c a filament, which must be heated, the tube can come into operation. the tube strikes (that is when c starts flowing through it) these fila are switched off by a small aut switch, called a starter switch. Ho the resistance of the tube, when st is extremely low, and we have t some means of limiting the startin rent. This is where the choke com Without it the tube would blow the and in all probability it would itself up in the process. You can see the above, that the ballast, which a fancy name for the type of cho quired, is very important indeed. economical operation, a condenser i required. You could approach your electrician for the circuit diagram.

And finally a word of warning. making or working with mains op equipment it is essential that it is fectly safe to eliminate the risk of el shock to anyone touching it.

P.F.L. (Moonee Ponds, Vic.) in about the 906 Modulation Checker asks if it is possible to use a 5BP1 with the same circuit. He also as it is permissible to use a transr without a licence, if the final amp does not draw more than 25 mA current.

We will answer your second qu first, P.F.L., because it is the mos portant one.

As we have often stressed in articles and replies to our readers transmitter, no matter how small, be put on the air without a licence the PMG. The Wireless Branch o PMG can give you all the inform on this matter and we suggest you tact them about your requirements

Regarding your first question, w not see why a 5BP1 should not wo the same circuit. Apart from the s connections, no alterations should necessary. We suggest you contact of our advertisers about the availa of the tube you want.

C.T. (Collingwood, Vic.) has that there have been inquiries Radio Rome and encloses a bo which gives some information on activities.

A. Many thanks for your practica terest and we have duly forwarded booklet to our short-wave correspon Art Cushen.

R.B. (Box Hill, Vic.) would lik know the purpose of a small metal which is usually attached to the ca support in a valve.

A. It is almost certain that the plate to which you refer is the "Ge It carries a small quantity of magne or similar material and is assemble the rest of the structure during course of manufacture. When the envelope has been sealed, heat prod by a high-frequency coil ignites the nesium which sprays on to the su of the bulb and produces the fam mirror-like effect. In the process magnesium combines with any ox that may still be left in the env and also continues to absorb it d the life of the valve. This help maintain the vacuum during the of the valve.

T.J.C. (Croydon, Vic.) intends to the Radio and Hobbies Standard T and wants to know what altera would be required to use a 6AE8 verter in place of the 6AN7.

A. As a rule the same oscillator can be used for these two valves the circuits will also be similar. slight modification to the screen ping resistor and bias resistor v may be necessary to obtain the opti voltages, but these adjustments are easily determined experimentally in form of a final adjustment.

M.D. (West Ryde, NSW) is tro by stylus wear and the accumulatio dust from his LP records, in spit

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

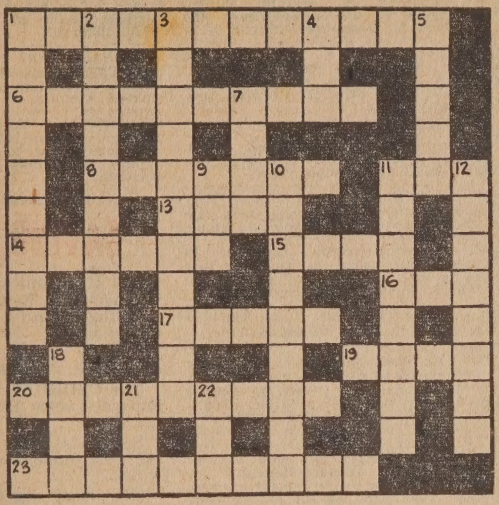
Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

E R. & H. CROSSWORD No. 11



CROSS

1. Television tube employing a mosaic.
2. Antenna support.
3. Sound associated with weak signals.
4. United States of America. (abbrev.)
5. Part of a transformer.
6. Sounds.
7. Valve electrode.
8. Part of a circle.
9. Unit of electrical pressure. (pl.)
10. Mimics.
11. Converter of energy.
12. Type of receiver.

DOWN

1. Reciprical of capacitance.
2. Grounded lead.
3. Compact communication equipment
4. Boot-maker's instrument.
5. Used in medical treatment.
7. Two.
9. Distress call.
10. Used for obtaining negative resistance. (pl.)
11. Continuous.
12. Distance from X axis
18. Caused by faulty stylii.
21. Printer's measurement. (pl.)
22. Radio firm (abbrev.)

Solution and further crossword next month

elaborate precautions to keep the records clean.

A. It is not unusual for the cantilever stylus mounting to show up the collection of dust more readily than other type having a longer stylus. The amount of space available between the arm and record surface is so small that only a small quntity of dust is sufficient to cause fouling. In the matter of stylus wear you do not say on what observations you base your assumption that the stylus is due for replacement or what type of equipment is being used. Assuming an amplifier and speaker having a wide range and (particualrly with a peak in the speaker) it is quite possible that wear on the stylus could cause noticeable distortion after only 20 playings. On less ambitious equipment or for a less critical listener it might easily be possible to increase this figure to 50 or even 100 playings. It might be advisable to have the stylus checked by the local distributors who should be able to advise you whether, in fact, the wear is of the order you suggest.

W.J.G. (Wheruapai, Auckland, NZ) inquires where he could obtain the front end assembly and valves for the 3-Band Six Receiver.

A. The unit used in the receiver was manufactured by Q-Plus, and is available from R. W. Steane and Co. Pty. Ltd., of Auburn, Victoria. They will most likely be able to send the unit to you. They will also be able to advise re price. The valve types used in the 3-Band Six receivers are better known in New Zealand as EF93, X79, EBF80, EBC80 and EL80. The last two could be replaced by an EBC41 and an EL41 if 8-pin lock-in sockets are used. No circuti modifications are necessary as they are electrically identical.

C.D.K. (Ipswich, Qld.) has recently built the AC Standard Five receiver and would like to know how he could eliminate the "little hum or buzz" he is getting in the "inverse feedback stage".

A. We do not quite know what you mean by the "inverse feedback stage" but we suspect that you are referring to the audio end of the receiver. In this kind of circuit it may be necessary to increase the size of the second filter capacitor, particularly if a large speaker is used with the set. Alterntaively, a larger filter choke could be used. It appears most likely that the filter hum is causing the trouble. Another point to check would be the shielding of the volume and tone control leads, also those to the pickup.

N.G.C. (Ivanhoe) sends in a year's subscription. He would like to see some discussions on radio valves and indivi dual sections of a receiver.

A. Thank you, N.G.C., for your subscription, we have forwarded it to the appropriate department. At various times we have described the functions of different sections of a radio receiver, the latest series being Teach Yourself Radio. In the February, '55, issue we discussed valve characteristics in "Let's Buy An Argument".

R.H. (Alphington, Vic.) submits two questions for the "Answer Tom" page.

A. Many thanks for your letter, R.H. Your queries may prove of interest to our readers and have been passed over to our "Answer Tom" writer with a possible view to including them in a future issue.

Last Month's Solution
February Issue

M	A	G	N	E	T	I	C	F	I	E	L	D
I	■	R	■	■	N	■	■	L	■	A	■	■
C	O	I	L	S	■	D	I	P	O	L	E	S
R	■	D	■	■	O	■	Y	■	I	■	H	■
O	S	C	I	L	L	O	G	R	A	P	H	■
F	■	O	■	E	R	■	O	■	S	■	■	■
A	N	N	E	A	L	■	I	N	D	E	X	■
R	■	D	■	D	■	O	■	E	■	■	■	■
A	■	E	L	I	M	I	N	A	T	O	R	S
D	I	N	■	N	■	I	■	E	■	U	■	■
■	■	S	■	■	H	■	S	E	C	O	H	M
■	P	E	N	T	O	D	E	■	T	■	U	■
■	■	R	■	T	■	D	■	S	■	M	■	■

Wanted to Buy, Sell or Exchar

Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for March issue of Radio, Television and Hobbies is Wednesday, March 9.

FOR SALE: Byer 55 Tape Recorder, Byer R.12.D Disc Recorder, 8 watt amplifier, spare tapes, microphone etc. Stop watch. Best offer. 12 **Premier Ave., Mitcham, Victoria.**

SELL: Complete P.A. System. 6V6 P.P. 2 channel pre amp. ribbon mic., stand, 12-K, 2 8-M speakers. Offers to £65. **Barber, RMB 245, Leeton, NSW.**

SELL: R & H 1946 to 1951, 2 short + 47 and 50 s/w H'bks. Offers. Open one month. **Mathews, 197 St. Johns Rd., Glebe.**

SELL: Communication receiver, 13 valve AR8. 140kc to 20 meg. 240v power supply and speaker, £20. **S. W. Hutchinson, 46 Bruce St., Stanmore.**

SELL: Acos GP20 little used Garrard motor. Both 78. £4. **LX6580, Sydney.**

SELL: All back issues R. & H. Many early copies in stock. 4/- per copy, incl post. Write now to **T. Weir, 73 Gibson Ave., Padstow** for prompt service. Spare copies or collections wanted. UY8056.

SELL: Expert P/V Diamond Stylus and Axiom 22 MK11. The both £30. **L. Russell, 57 Sixth Avenue, Berala.**

SELL: Goodmans Axiom 150 speaker, Plessey 3-speed changer, classical records, "gramophone" magazines. **Rooke, Melbourne. FU7049.**

SELL: Palec Valve/Circuit Tester VCT-2. As new. £40 or offer. **UL2956, Melbourne, - Sundays.**

SELL: Printing. Special Offer:—100 Business or Visit Cards, 30/-; 100 Letterheads, 30/-; 200, £2. Sent anywhere by mail. Do it now! **W. Hiley, 841 George St., Sydney.**

SELL: WRN Transcription PU £12. 5in PPCRO £12. **No. 3 Market St., Drummoyne.**

WANTED: Radio Service Manuals Nos. 1, 6, 8 and 9 wanted urgently. Offers to **E. Smoderek, 16 Chrysler Rd., Croydon Park, Adelaide, SA.**

WANTED: Record cutting gear 78 rpm. Prof. Presto etc. **Mill, 339 Sussex St., Sydney, MA4541.**

WANTED: SCR522 Transceiver unconverted, good condition, please send details price, etc to **Hill, 15 Morgan St., Petersham.**

WANTED: Standard discs o Mikado (1927 recording). W chase, or exchange LP's of Pina Pirates. Write **B. Wallace, c/- 2NZ, Inverell.**

WANTED: AR7 receiver. ATR ATR2B transceiver field s meter. Particulars **N. E. Golding burton, Victoria.**

PERSONAL: Tuition by qualif structors for PMG 1st and 2n certificates and amateur licence typing to morse a specialty. **XW6256.**

SAVING WATE

THE Commonwealth Scientifi Industrial Research Organ is trying to find a way to stop evaporating.

Success would help paste save huge amounts of water.

The CSIRO has been workli tensively since 1940 on water oration.

Scientists have been experi ing with fluids floating on top water.

The most successful so fa been cetyl alcohol.

Scientists say the cost may low as a 10th of a penny for 1000 gallons of water saved.

A CSIRO spokesman said outside experiments with cetyl hol showed a 50 pc reduction in oration.

The organisation would hol this summer in New South Victoria, Queensland and W Australia.

Cetyl alcohol comes from t of sperm whales.

It is easily synthesised.

SCOTCH ELECTRIC TAPE

(Continued from Page 89

"Scotch" Electrical Tape N with cotton cloth backing is from cotton which has been w with de-ionized water to remov traces of chlorine or other cor material, and thus has a min of soluble salts. This tape is heavier than an ordinary print and possesses a high puncture tance to electrolysis and high t strength.

It is designed for such applic as snubbing coil ends on m for splicing leads, surge bandi a "shroud" between the lamin and commutator, as a build-up the balancing ring, &c.

It possesses the property of lent varnish penetration and to bake dry, and when thus in nated, it acquires properties similar to those of varnished bric, plus being self-anchorin provides additional dielectric tection, as well as increasing ph protection and has good resi to tearing.

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